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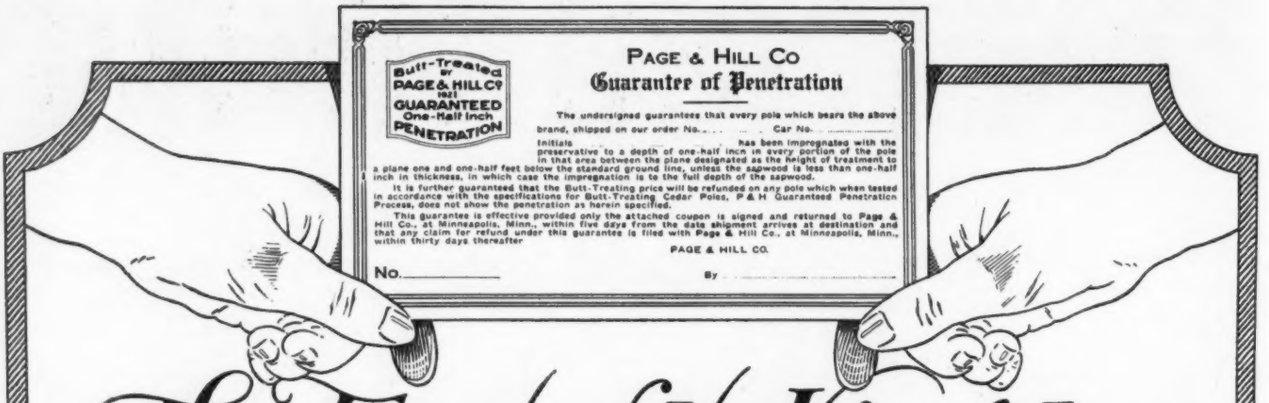
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Electrical World

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National Work Done in a National Way

DURING the past few weeks the National Electric Light Association has accomplished three things which stand out pre-eminently to its credit. Its water-power committee after weeks of labor in Washington has had the Federal Power Commission rules and regulations reopened and will probably succeed in having them made workable; the public policy committee has made more flexible the structure for financing in the standard system of accounting adopted by the National Association of Railway and Public Utility Commissioners, and a special committee has reached an understanding with a committee representing national telephone interests whereby inductive-interference difficulties will hereafter be amicably adjudicated. Thus in a remarkably short time conditions which have vexed the electric light and power companies of the country for very many years have been adjusted and the road cleared for speedy and satisfactory solution. This is national work performed in a really big and national way.

Yap and Modern Methods of Communication

WITHOUT going into the merits of the Yap controversy, it looks as if the United States had been rather successfully buncoed. The ethics of the situation is not the thing to which we want to call vigorous attention, however, but the necessity of the United States carrying out so complete a system of radio communication as to make it quite a matter of indifference whether sandbanks and coral islands do or do not fall within the sphere of the Volstead act. The time has now come when Great Britain has a pretty complete scheme for wireless communication over the world, and there is every possible reason why the United States should follow suit, since it is much easier, as experience has already shown, to cut a cable than it would be to jam successfully a modern wireless system. A cable once cut is out of business for a considerable time, while no amount of jamming is anything more than a temporary annoyance to a wireless plant. We have already made an admirable beginning with our several high-power stations, and if Congress takes a serious interest in the possession of Yap as a cable landing it certainly should take equally great interest in the construction of wireless stations such as would make that interesting island little better than a flyspeck on the map of the Pacific. So much splendid work has been done in the wireless line by American engineers that it is merely paying them a proper compliment for the government to push their work to the limit and make the United States both for military and commercial purposes quite independent of the conductors stretched on the bed of the ocean. These cables have done admirable service for the world's communication over a long period and probably will still continue in use for another long period, but there is not the least reason for worrying over their control or possession by foreign powers if we make the most of the radio systems already developed.

The Illuminating Engineers Should Not Move

WHEN in the winter of 1903 the late Andrew Carnegie made his generous contribution for the erection of the Engineering Societies Building and the Engineers' Club in New York City, the assumption was that the former edifice would be a temple of engineering to which all engineers might come. This it has been, to the gratification and convenience of the engineering profession. Now, however, for some reason by no means impossible to overcome, the Illuminating Engineering Society, small in numbers but not in accomplishments, is faced with the necessity of finding quarters elsewhere. This it can doubtless do without great sacrifice or cost, but this it ought not to be permitted to do. The building on West Thirty-ninth Street was erected for just such national technical societies, and certainly what little room the Illuminating Engineering Society requires can yet be found in it. Nor should the illuminating engineers be stuck in an out-of-the-way corner. They are the exponents of light, not darkness; and while they possess the skill to turn darkness into light, we presume they prefer natural illumination. If the United Engineering Society and the illuminating engineers will reason this thing out together, we are sure there will be no occasion for parting.

An Opportunity for Government Help

IF, AS has been intimated, the government desires to aid and not hinder business, it will find opportunity to gratify its wish legitimately. We have in this country at least one national body needing and deserving government support—the American Engineering Standards Committee. It is not unlike the British Engineering Standards Association, which has done so much in developing British industry, and similar standardizing bodies existing in a dozen other countries. They are not governmental bureaus, but are composite bodies made up of representatives of national engineering and industrial associations. The function of the American Engineering Standards Committee, as indeed of all the standards committees of the various nations, is to systematize methods of co-operation between the different national bodies in order to correlate the work of standardization, devise codes and standards, prevent duplication and

conflict of effort, and thus increase greatly the efficiency and economy of production and utilization in industry. The American Engineering Standards Committee is working in close co-operation with six national engineering societies, five government departments and thirteen national industrial associations. Since its organization a little more than two years ago it has done very creditable work in this country and has promoted in foreign countries the knowledge of recognized American standards and aided in international engineering standardization.

Ventilating Open Rotating Equipment a Design Problem

THE provision of an air supply to rotating machines that will insure adequate ventilation is as much a part of good station design as is the care exercised by the designer in providing internal means for machine ventilation. This point is frequently lost sight of in plant design except in the case of totally inclosed machines, where special means of providing for ventilating air must of necessity be adopted. Open rotating equipment is ordinarily so installed that there is no provision for air supply beyond the leaving of sufficient wall openings or the placing of fan equipment to force the air estimated to be required into the room. So long as machines are not crowded or seriously overloaded no ill effects are observed, but when developments necessitate placing them in close proximity or in such positions that air from one machine is carried by the natural room currents past other machines serious heating effects due to the recirculation of warm air are observed. Observation of plant conditions leads to the belief that this situation is a much larger factor in operating troubles than is realized. In the last two or three years a number of cases of rather serious effects from air recirculation have been observed. No reasonable increase of air in the room's supply appears to help matters materially, and it has been generally found by test that air is being recirculated by each indvidual machine or that the air from one or more machines is being carried by room currents to other machines and recirculated. Experimental work with various schemes designed to break up recirculation is being carried out on existing installations with varying degrees of success, but the problem, if it is to be satisfactorily solved, must be met by proper provision for ventilation in the original design. It is a design problem and cannot, in general, be handled efficiently on any other basis.

Intensive Relay Inspection Fully Justified

HUMAN vigilance and supervision over control apparatus will make it operate with what almost seems uncanny intelligence, while lack of supervision will render it absolutely useless. The more nearly perfect a piece of apparatus is, however, the more it requires the attention of its master. There is no better example of the truth of this statement than in the matter of relay systems. Under proper supervision relay systems will perform duties with astounding accuracy, while the least defect in the smallest part may result in complete disorganization of the entire system. While all believe and know that successful relay operation depends on adequate inspection, tests and constant attention, many fail to apply these requisites of operation to their system. It is therefore interesting and of educational value to read Raymond Bailey's paper in this issue on "Relay Tests and Inspection" and to study his recommendations. Mr. Bailey inspects relays before installation and carries on tests not only for electric soundness but also for sensitiveness of operation. The information thus obtained is used in finding the best place for each relay in the system. After the relays are installed other tests are applied to make certain that their operation will be dependable. When a relay has been once put in a system and is being depended upon to perform its duties it is inspected at regular intervals and tested at other intervals less frequent.

Recommendation is made by Mr. Bailey to create a department with the specific duty of taking care of relays. Although some may feel that his methods are too intensive, it is only necessary first to realize the very purpose of relays and secondly to analyze some of the large failures in big systems in the last few years to realize that any effort to improve operation of relays will be well justified by saving of apparatus and improvement of service.

Experience and Study Go Hand in Hand

FROM one viewpoint engineers can be grouped into three classes. There are a few shrewd and competent practical engineers who pay little attention to the published experiences of others and seldom consult books and magazines devoted to their line of work. Their entire store of knowledge, experience and judgment is carried in their heads or is contained in whatever card catalogs, curve sheets, drawings and similar records they have in their offices. On the other hand, there are engineers with the instincts of compilation who are fond of collecting and consulting all kinds of printed information. An engineer of this class may not be able to decide on the best solution in a given case, but he can readily tell what various authorities have advised in similar instances. Both these types are extremes, and neither can be trusted in an important engineering problem involving new features. The third type of engineer, seldom found among the job hunters, is the one who is active in his professional society, who reads at least one leading technical paper regularly and who co-ordinates his practical work with what he reads in new books and periodicals. In other words, a progressive engineer accumulates his own practical experience and judgment on a background of the much more extensive published experience of the leading men engaged in his line of work. In this way he is not apt to generalize from miscellaneous data or be misled by rule-of-thumb methods found useful in his own narrow field, but is more liable to preserve the correct perspective. On the other hand, when his data are confirmed by printed information he feels doubly assured in following the results of his own experience.

Unfortunately, many engineers think that they can find reliable printed information on short notice, without previous training in library search. This is a delusion which sometimes leads to serious disappointment. Only he who follows the current engineering literature more or less regularly can find what he needs with ease and assurance, can assign the proper relative weight to contradictory statements and can be reasonably sure of not having omitted any important reference or clue. Offhand statements on engineering topics

are sometimes made on the floor of a convention or in private discussions that are based on old information. They may be the half-baked conclusion of a young enthusiast, they may be the result of honest experience but experience under special, narrow conditions, or they may be an insidious attempt at advertising a piece of apparatus or some other commodity. It takes long experience to place such statements where they belong, and the only way to gain this experience is to read at least one periodical regularly, so as to be able to analyze every contribution about as quickly and as surely as an editor of long experience and training does. The same consideration, of course, applies to new books.

The critical period in an engineer's career comes soon after he leaves college when he has to shift for himself so far as his mental food is concerned. Then is the time to develop the habit of reading at least one technical magazine regularly, of cutting out and filing useful articles or notes, of following up references to other magazines, of reading book reviews and glancing at publicity pages and advertisements, personnel changes and so forth. Such a practice not only becomes easy later on, but becomes as indispensable a part of one's life as the reading of a daily newspaper. And it may be said without exaggeration that for many a young engineer this choice between reading and not reading a professional journal means in the end the difference between settling down to a narrow routine, with a blind alley at the end, and pursuing a steadily broadening path to varied and satisfying activities.

Suspension Insulators and Unequal Spans

WITH transmission-line spans of different lengths it is a well-known fact that suspension insulators will hang in a vertical position at only one given temperature. In other words, if a line as a whole is strung for one particular condition, the insulators will swing one way or the other from the tower for all other conditions. Further, in stringing a transmission line the ideal would be so to build a line that uniform stress would result in insulators hanging vertically at the maximum loading. Over rough country with spans of different lengths it will be necessary, in order to obtain these conditions, to string each span at the proper tension based on the maximum load planned and then to let the suspension insulator find its position after the clamp is fastened. This would be an expensive and difficult process.

In this issue Murray J. Idail points out in a short article on "Stringing Suspension Insulator Lines in Rough Country," that advantage can well be taken of the fact that suspension insulators, while swinging one way or another from the tower, will make up for uneven stresses in the spans. Saving and simplicity will result from pulling the wire between two dead-end strains over uneven span lengths at some definite tension determined by the temperature at the time of stringing and the maximum conditions for which the design is made. The wire between the spans will find its proper position if allowed to roll freely over blocks. Further, Mr. Idail shows that in general it is preferable to determine this stringing tension by means of the equivalent span as defined by him rather than by the average span, this resulting in less severe stressing conditions in the longest span under consideration. However, it is well to check up under extreme conditions of varying span lengths what the tension on the longest span will be before stringing the wire. The article also indicates how this should be done and brings out clearly that satisfactory results are obtained in most cases by the simple method of pulling the wire from one end, at some determined tension between two dead-end points.

Is Not Greater Accuracy Practicable in Sphere-Gap Measurements?

THE distribution of electric field or voltage gradient between spherical electrodes obviously varies from point to point, being a maximum along the line joining their centers. It is interesting, therefore, that for given spheres under constant conditions the sparking difference of potential has a definite and remarkably constant value. The explanation doubtless lies in the fact that the extended surface of the spheres acts as an electrostatic screen to the central region on the line between centers, just as the outer portions of two parallel planes act as guard rings to the central section. We find, therefore, that with increasing distance between spheres the spark-over voltage becomes less constant, that is, more subject to electrostatic influences of surrounding objects. There is also a limiting minimum value of space separation, about 1 mm., below which the sparking voltage is not constant. In this region the distance of separation is comparable with the mean free path of the gaseous ions which cause breakdowns. If this mean free path is limited, breakdown does not occur.

The computation of the maximum electric stress between two spheres has attracted the attention of many investigators. Owing to the dissymmetry of the arrangement the problem is not simple. One of the most persistent workers in this field is Dr. Alexander Russell, who presented some interesting new data in a paper in the *Journal* of the (British) Institution of Electrical Engineers not long ago. He offers a greatly simplified formula for the maximum electric stress in terms of the potentials of the equal spheres, their radii and the distance between them. The simplification consists in an approximation to the extremely complicated function of the radii and distance of separation which appears in the exact solution. Applying the formula to some of the most careful experimental values of sparking distances, the agreement between the computed and actual values is found to be remarkably close when both spheres are insulated. Moreover, it is shown that for any one value of the radius of the spheres the maximum stress corresponding to breakdowns is a constant, the law being almost the same as that given in the "Standardization Rules" of the American Institute of Electrical Engineers.

A matter of great moment to American engineers, however, is the fact that Dr. Russell claims that there are errors in the values of sparking voltages, as given in the "Standardization Rules" of the Institute, for the case of one sphere connected to earth. In fact, it is suggested that in the observations on which the "Standardization Rules" are based the grounded sphere was not actually at zero potential. The value of this criticism lies in the excellent agreement of Dr. Russell's formula with other experimental results. While, therefore, it cannot be stated that his conclusion is definitely proved, nevertheless a doubt is thrown on the accuracy of one of the Institute's important standards which cannot be lightly passed over.

Bernard Edward Sunny

One of the ablest executives of the electrical industry, whose organizing and administrative powers have had a real influence in the development of the telephone, central-station and electrical manufacturing industries

PROMINENCE in the development of two more or less unrelated phases of the electrical industry is an achievement that seldom falls to the lot of one man. Such is the accomplishment of B. E. Sunny, who belongs to the unusual type of corporation executive in whom are combined the ability to pilot a huge commercial undertaking and the acquirements of a technical expert. The telegraph field claimed him at the age of sixteen. In the employ of the Atlantic & Pacific Telegraph Company he became an operator and was transferred from Brooklyn, N. Y., where he was born in 1856, to Chicago, where while still in his "teens" his ability won for him promotion to the position of night manager of his office, of which he soon became manager.

Bell's invention of the telephone, which was then attracting widespread interest, led Mr. Sunny to apply himself to a study of this instrument with such practical effect that in 1879 he became superintendent of the Bell Telephone Company in Chicago. Then only twenty-three years old, he foresaw the future development of the telephone business and entered into his new duties with enthusiasm. During this period the old Bell and Edison Telephone companies were merged and the Chicago Telephone Company was formed.

Before very long Mr. Sunny's administrative ability attracted attention outside of the telephone field, and in 1888 he was called upon to take the presidency of the Chicago Arc Light & Power Company, at that time one of the largest central-station companies in the country. Two years later he became Western manager of the Thomson-Houston Electric Company, and such was his success that on the merger of the Thomson-Houston, Brush and Edison General Electric companies he was placed in charge of the Western interests of the new organization. He later became a vice-president of the General Electric Company and also of the American Telephone & Telegraph Company. He returned to the telephone industry in 1908, when a man who could combine executive ability with technical knowledge and a thorough appreciation of the problems of public utility service was needed. He became president of the Chicago Telephone Company and chairman of the board of directors of the Central Union Telephone Company, both now succeeded by the Illinois Bell Telephone Company.

Mr. Sunny believes that the only problem involved in the relations of corporations with the public is that of arriving at a mutual understanding. He has the courage of his convictions and has always expressed them with the utmost frankness. A recent example of this trait is the announcement made by him that so far as the Illinois Bell Company is concerned the war emergency is over and no further operating troubles can be charged to that cause.

Relay Tests and Inspection

Reliable Operation Demands that Utmost Attention Be Given to Routine Tests, Adjustment and Inspection Before and After Installation—Advantage of Making One Man Responsible for All the Relay Installations

By RAYMOND BAILEY
The Philadelphia Electric Company

SINCE the failure of a single relay contact to function properly may result in the complete shutdown of a part or all of an electric system, it is highly important that the utmost attention be devoted to routine tests, adjustments and inspection of relays and relay systems. Some of the methods of the Philadelphia Electric Company are herewith presented with the thought that they may be of interest and stimulate discussion. Only those types of relays which are more or less standard in their application will be considered.

The first step in the procedure should be thoroughly to inspect all the working parts of the relay to make sure that it is in good condition before being placed in service. All contacts should be carefully gone over to insure that they are properly lined up and making good contact. Potential should be applied to the contact system and to the coils of the relay to make sure that the insulation is satisfactory. The exact voltage used for this test may vary according to conditions, but in most cases it will be in the neighborhood of 1,000 volts. Excess-current time-limit relays should be checked for the minimum operating current at the different points, and it is also well to check the time required for the relays to function upon various currents. After this has been done, the relays may be set for desired current and time, if desired, and sent out for installation.

Directional relays usually have excess-current time-limit relays installed in conjunction with them. In some cases the excess-current relay is inclosed in the same case with the directional relay, while in other cases it is a separate unit. The following statements made concerning the testing of directional relays will apply, however, in either case:

In addition to making the general inspection and potential test which should be made on all relays, the directional relay should be adjusted so that it will operate satisfactorily on very low power factor and voltage (in most cases 1 volt). The current used during this adjustment should be in the neighborhood of 35 amp. or 40 amp. if a current as great as this will exist in the current transformer secondary under short-circuit conditions. If the directional relay is not adjusted properly, it may require more time to operate under a severe short circuit than the excess-current relay, resulting possibly in the loss of selective action. Energy should be passed through the directional relay in order to check its action to make sure that the contact will remain open when the power is in the normal direction and closed when power reversal occurs. A check should be made of the minimum operating current of the excess-current element and the time required for it to function. After the relays have been adjusted for the desired current and time they are ready to be sent to the station.

Double-winding differential relays, in addition to the general inspection, should be checked for operating current. The ratio of turns on the two coils of each relay can be checked very easily by means of the special test core, the use of which was described in detail in the issue of the ELECTRICAL WORLD for Feb. 21, 1920.

During this test it is well to read the voltage induced in the test coil when one of the relay windings alone is carrying the current that will exist under normal load conditions; the other coil on the same relay should carry no current at all. The same test should then be repeated, using the second coil. Another reading of induced voltage in the test coil should be taken when both coils are carrying the current they will carry under load conditions and connected so that they tend to produce zero resultant flux in the relay core. These voltage readings indicate whether or not the relay has been wound with the correct ratio of turns and which coil leads should have the same instantaneous polarity to give the desired balance.

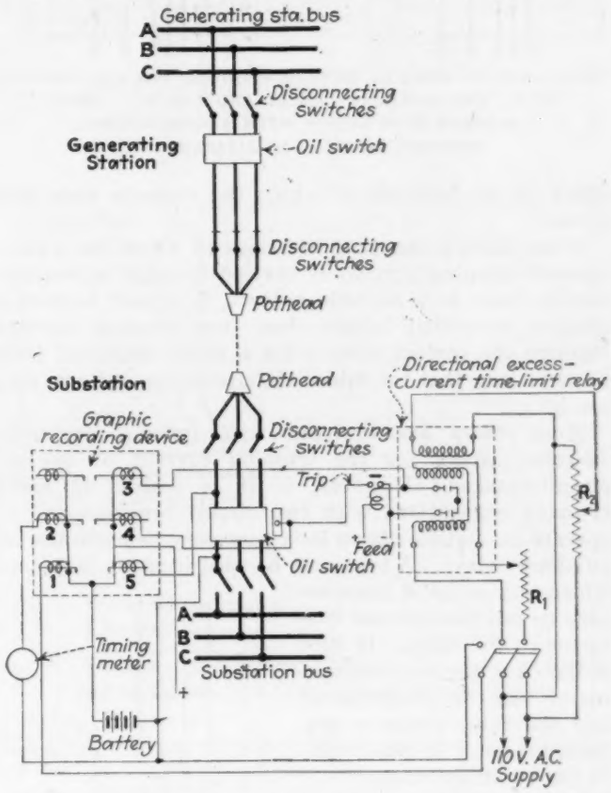
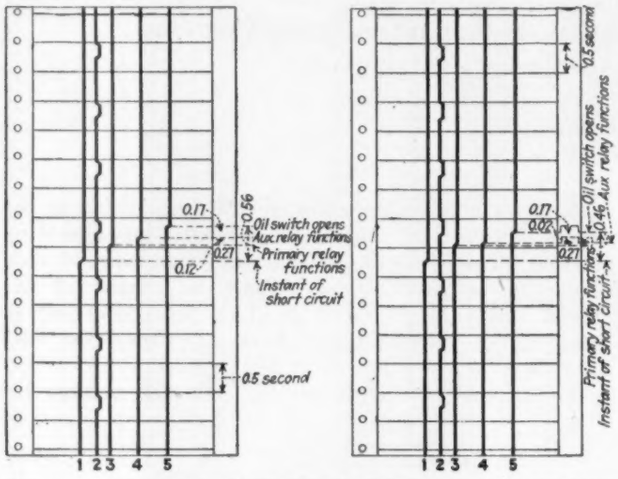


FIG. 1 — CONNECTIONS BETWEEN FEEDER RELAY AND ELECTRICALLY OPERATED GRAPHIC RECORDING DEVICE USED TO CHECK SELECTIVE ACTION OF RELAYS

There is very little that can be done in the laboratory in the way of preparing single-winding differential relays for installation further than the general inspection, adjustment and check of operating current.

The test on under-voltage relays should include a



FIGS. 2 AND 3—TIME IN SECONDS REQUIRED FOR THE PRIMARY RELAY, THE AUXILIARY RELAY AND THE OIL CIRCUIT BREAKER TO FUNCTION WITH A SLOW-ACTING AND QUICK-ACTING AUXILIARY RELAY

check of the voltages at which the contacts open and close.

When testing the types of relays in which the direct-current tripping current is carried through springs or flexible leads to a movable contact, it is well to pass a current somewhat larger than this tripping current through the contact system for a short length of time to make sure that the soldering, circuit connections, etc., are all right.

Most relays are equipped with internal contactor switches caring for the tripping current of one oil circuit-breaker. However, if it is desired to make tripping connections with two circuit breakers and to operate an audible alarm it is necessary to make use of auxiliary relays. A type may be used in many instances which will make it unnecessary to use the internal contactor in the relay. If such is the case, the internal contactor can be disconnected and the relay contacts connected directly in the circuit to the auxiliary relay.

When certain types of relays are under consideration it is advisable to make special tests on them, in addition to those outlined above, in order to determine their adaptability for the intended service. Tests which should be included in a case of this sort will in many instances suggest themselves, depending upon the conditions to be met. The following tests, however, are mentioned because results obtained from them will in most cases be found to be of value.

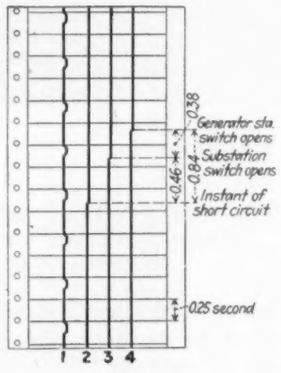


FIG. 4

Time in seconds from instant short circuit to the points at which the substation and generating station oil circuit-breaker contacts parted.

Usually it is desirable to make a series of tests to determine the accuracy of the relay. By operating the relay a number of times the variation in operating current, time and so forth can readily be determined. The results obtained from a test of this sort will have considerable bearing upon the settings given to the relays when they are installed.

When the relay settings are being determined the characteristic curves should be studied, as the various types of relays have differently shaped curves with the result that even though there may be sufficient time difference between relays at the two ends of a feeder when operating on the test current, this time difference may disappear altogether on a current of the magnitude produced by a short circuit.

Excess-current relays should have passed through them a number of times a current as large as that which will result under the most severe short-circuit conditions. If there are any weak or defective points in a relay, they will no doubt become evident at this time. The performance tests of the relay should always be made under conditions which approach as nearly as possible those which will exist when the relay is required to function after it is installed.

Potential tests using 1,000 volts will indicate where insufficient or defective insulation exists.

The disk of an induction-type excess-current relay will not return immediately to its initial position after an excess current has passed through it unless the current in the relay is reduced to zero instantly. If the excess current has not opened the circuit, the relay disk will return slowly so that if another swing occurs very soon the relay will function in less time than desired. It is a good plan to find out just how the relay under consideration will act in this respect.

The ability of a relay to carry the tripping current of an oil circuit breaker satisfactorily is of considerable importance. In most cases the relay contacts are not required to open the trip circuit, this being usually opened at the oil circuit breaker.

The volt-amperes required by and the power factors of different relays under normal conditions should be compared. Excessive volt-ampere requirements at low power factor will increase the error of the current transformers.

The sturdiness and simplicity of construction and ease of adjustment of the relays under consideration are important factors and should not be overlooked. A relay which is so arranged that the adjustment can easily be changed by an unauthorized person or so that the contacts could be closed accidentally is very undesirable. It is important that the relay be absolutely dust-tight since the presence of dust may prevent the relay from doing its work.

TESTS PRIOR TO PLACING IN SERVICE

After relays have been installed they should be gone over very carefully to make sure that they have not been damaged during the process of installation, that all connections are correctly made and that all contacts are lined up properly. It is particularly necessary to check the current and time settings of excess-current time-limit relays.

The connections of directional relays should be carefully checked as inaccurate connections may cause serious trouble. This test can be very readily made without removing any of the relay connections by means of a special test device described in the issue of the ELECTRICAL WORLD for Feb. 5, 1921.

Whether or not all connections to double-winding

differential relays are correctly made can be determined by means of the test core referred to above.

The correctness of the connections to single-winding differential relays can be checked under load by putting an ammeter in the relay circuit. This instrument should, of course, indicate zero current, if all connections are correct and current transformers of the proper ratio have been installed.

Special Tests on Completed Installations

Even though the individual relays at the two ends of the feeder have been checked separately, it is advisable in some cases to make a check of the complete relay installation to determine whether or not the desired selective action will be obtained. Fig. 1 shows apparatus

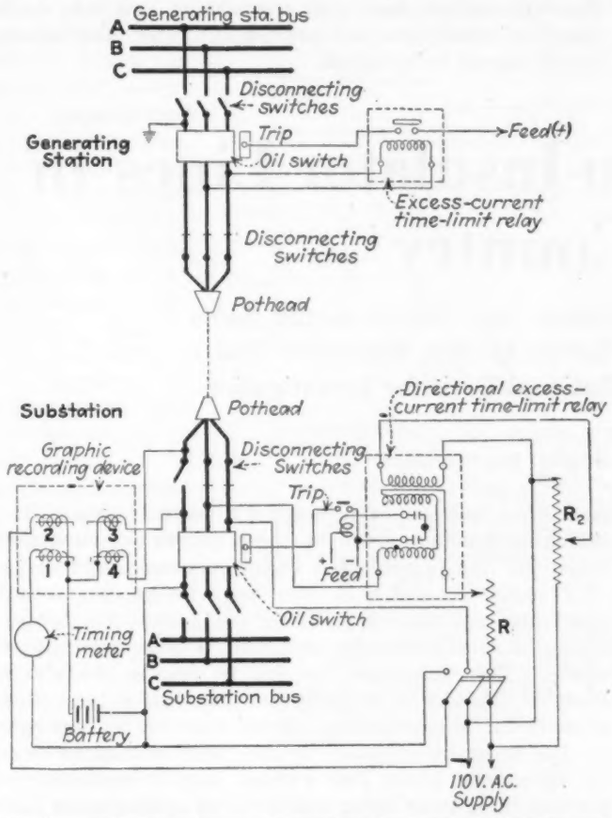


FIG. 5 — CONNECTIONS TO DETERMINE THE TIME REQUIRED FOR THE VARIOUS PIECES OF EQUIPMENT TO FUNCTION

and connections which may be used for a test of this sort.

From the illustration mentioned it may be seen that the relays at both ends of the feeder are energized simultaneously with a current of any desired value, which may be, if desired, equal to the calculated short-circuit current.

Resistor R_1 is used to limit the current in the relays to the desired value. Resistor R_2 is employed to give reduced voltage on the potential coil of the directional relay in order to study its performance under conditions very much the same as exist during a short circuit. The time required for the oil-circuit-breaker contacts to part is recorded on a chart by means of electrically operated pens. One of the pens is operated every half second by means of a timing meter. The second pen deflects when the short-circuit current is applied to the relays, the third and fourth when the breaker at the substation and generating station ends of the feeder open.

A typical chart taken during a test of this sort is represented in Fig. 4. This chart shows very clearly the time from the instant of short circuit to the points when the contacts of the substation and generating station breakers start to open, and the time between the breakers at both ends of the feeder.

In some instances it will be found necessary to make an analysis of the time for the various pieces of equipment at one end of the feeder to function. Connections shown by Fig. 5 should be employed in this case. The chart obtained from a test of this sort will give the time from the instant of short circuit to the closing of the primary relay contact, to the closing of the auxiliary relay contact and to the opening of the breaker. Fig. 2 shows a chart taken on the feeder, which was

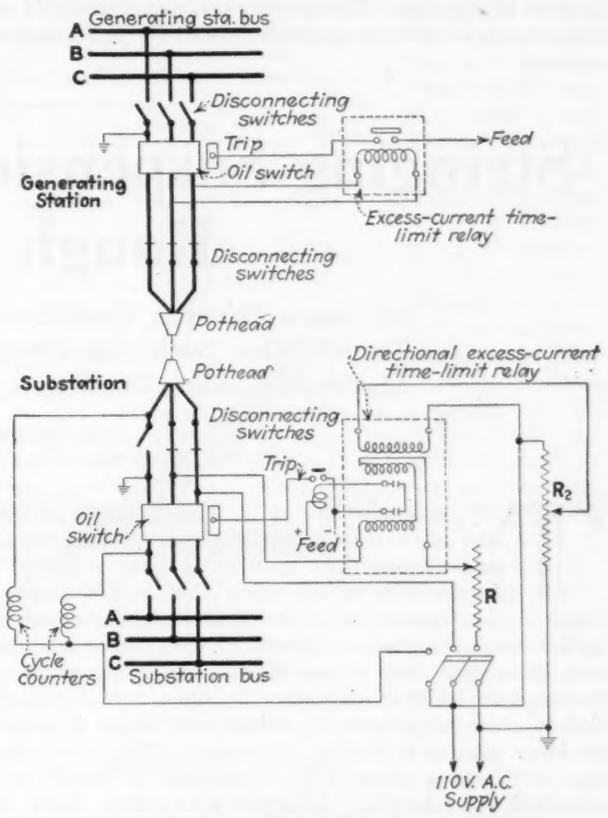


FIG. 6—CONNECTIONS BETWEEN FEEDER RELAY EQUIPMENT AND CYCLE COUNTERS FOR CHECKING SELECTIVE ACTION

equipped with an auxiliary relay requiring an excessive amount of time to function. Fig. 3 is a chart taken on the same feeder after a quick-acting auxiliary relay had been substituted. A comparison of these two charts will show how easily a slow-acting auxiliary relay may destroy selective action.

In addition to impressing reduced voltage on the directional relay, low power factor is employed in these tests in order to determine whether or not the relay will function satisfactorily on both low voltage and low power factor.

A slight modification of the connections of Fig. 5 makes it possible to determine whether the directional relay contact closes in less time under all conditions than the excess-current relay contact.

Cycle counters are very useful in making various tests and can be utilized for checking selective action between switches on a feeder by employing connections similar to those shown in Fig. 6.

In order to obtain desired results from relay protective systems it is advisable to follow a definite schedule of inspection and tests. Every two weeks an electrical test should be made to reveal the operating condition of the relays. For this test it will be found convenient to operate the relays by means of a bell-ringing transformer which can be mounted complete with connections in a carrying case. This test is easily made and enables one to determine whether or not the relays will operate when current is applied to them and whether or not they will trip the oil circuit breakers.

A thorough inspection should then be made to see whether the relay element has returned to the normal position, whether the contacts have opened properly and whether they show signs of burning, or if they are in need of cleaning. The presence of metal particles or other foreign material should be looked for and guarded against.

The current and time adjustments of excess-current time-limit relays and the performance of directional relays on low voltage should be checked at intervals of not more than one year.

Complete records should be kept of all of these tests and inspections as to the condition of the relays both "as found" and "as left."

It is a good plan to make one man of the proper training and experience responsible for all of the relay installations throughout the system. The routine inspections made every two weeks could be taken care of by the operating force, but all uncertain operations, defects, etc., should be reported at once to the relay engineer. If this man realizes the importance of the relay protective systems and the necessity of making rigorous routine tests and inspections and sees to it that his instructions are carried out most satisfactory results should be obtained.

Stringing Suspension-Insulator Lines in Rough Country

All Spans Between Dead-End Towers Are Pulled to the Same Tension, One Such that Elastic Limit Is Not Exceeded Under Maximum Loading Conditions—Rational Basis for Investigations

By MURRAY J. IDAIL
Electrical Engineer with F. R. Weller, Washington, D. C.

THE construction of a high-voltage (66,000 and above) transmission line through rough and mountainous country involves a problem in methods of stringing that is not encountered in construction through flat and regular country. In flat country a standard length of span can be adopted and adhered to more or less closely. In rough country, however, it is often necessary to span across valleys and to place structures on ridges and knolls in order to keep adequate ground clearance. This construction, of course, renders it impossible to adopt any standard span length. Adjacent spans may differ in length by several hundred per cent. This particular characteristic of mountainous construction must be taken into account in stringing wires and conductors. The problem is further complicated by the use of strings of insulator disks in suspension position, since different tensions cannot exist in adjacent spans except at dead-end towers.

Rather than to blindly string the sections of line to the tension proper to the average of all the span lengths in the section (which naturally first suggests itself as the most fitting tension) an investigation was undertaken to determine upon a more exact and justifiable basis for the stringing tension. Based upon the consideration of the unstressed length of conductor between strain towers, a formula was determined for a common stringing tension for all spans in the section. This formula, though empirical, is sufficiently accurate for all practical purposes and holds for both steel-covered aluminum and copper conductors.

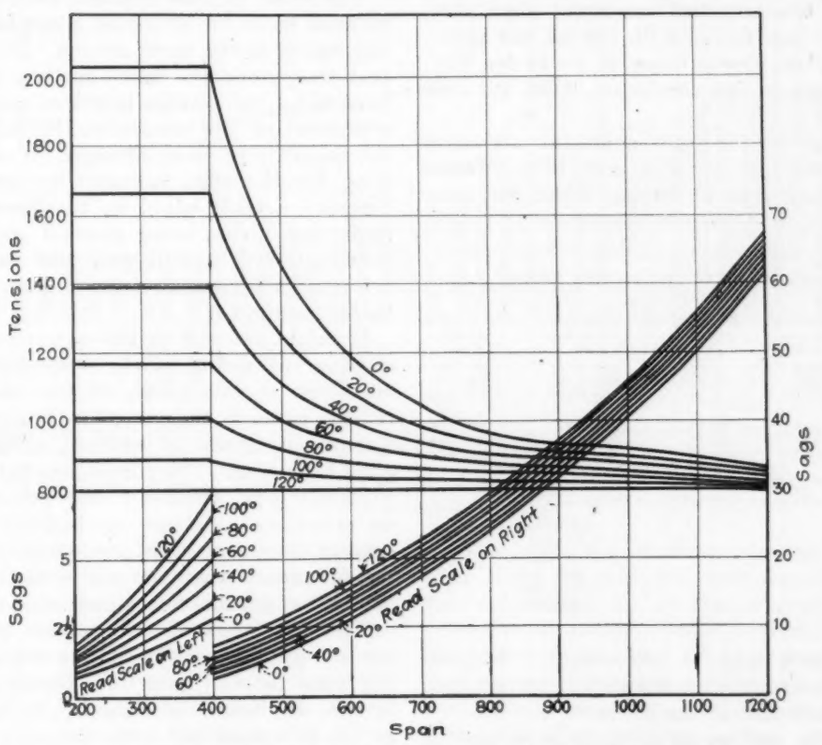
The curves for use in stringing the conductor are usually plotted tensions in pounds and sags in feet against span length in feet, curves being given for each of a number of atmospheric temperatures. The stringing tensions given by these curves are such that when the line is subjected to its maximum load—½ in. (1.27 cm.) ice and 8 lb. per foot (39 kg. per sq.m.) wind pressure at 0 deg. Fahr. (—18 deg. C.) for example—a certain definite maximum tension exists in all spans. This maximum tension is usually the elastic limit of the wire or slightly less than this value. Such a basis for the stringing curves assures the strength of the wire being used to the best advantage—*i.e.*, all spans are given just enough sag in stringing to prevent them from being overstressed at maximum load. These values of sags and tensions given by these curves will be referred to as the theoretically correct stringing values. The curves show that the longer spans require a lesser stringing tension than do the shorter spans. This means that, while the stringing tension curve for a conductor at ordinary atmospheric temperature is a curve resembling somewhat a section of equilateral hyperbola, the tensions existing in all spans under the conditions of maximum loading would be the same.

Basis for Rational Method of Stringing

Consider a line containing spans of greatly varying length. If in the construction of the line the insulators at each end of every span could be placed in the strain position and the conductors dead-ended thereto, the proper stringing tension for each span could be read directly from the curves and the conductors strung accordingly, the sag and tension in every span being entirely unaffected by adjacent spans. However, there are several reasons which render it inadvisable to dead-end each span. In fact, dead-end (*i.e.*, strain) structures are usually avoided as much as possible, sus-

pension structures being preferred. In mountainous country, however, on account of the great difference in length of many of the spans adjacent, it is necessary to provide a greater number of strain structures than is otherwise desirable. This is especially true when the line is being constructed at right angles to the general run and range of mountains. Under these conditions sections of more than four or five spans between dead-end points are rarely found.

Take, then, the case of a section of line comprising three suspension structures (*i.e.*, four spans) between dead-end points. As noted above, the spans on either side of a strain structure are unaffected by one another; that is, any tension can exist in the wires of one span without reference to the tensions existing in the other. Inherently, however, a suspension structure is incapable of maintaining a difference in conductor stress in the spans on either side of it. Any tendency for a greater stress to be set up in one span is immediately compensated by the insulator string swinging toward the greater stress, thus maintaining an equality of tension throughout all spans of the section. It is evident that with the insulator strings on the suspension structures kept in their proper positions—vertical or nearly so—the longest span in a section must at all times have exactly the same tension as the shorter span. As above noted, however, the stringing curves show that the proper tension for a comparatively long span is considerably less than that for a shorter span. The problem, then, is this: What stringing tension used for all spans of a section of line (*i. e.*, the section as a whole) will cause all spans in the section to be stressed to the maximum safe value under the conditions of maximum loading?



STRINGING CURVES FOR NO. 4/0 STEEL-CORE ALUMINUM CONDUCTOR

Curves are based upon equal sags at 0 deg. Fahr. with ⅜-in. Siemans-Martin steel ground wire. This sag is safe for conductor at 0 deg. Fahr. with ½-in. ice and 8-lb. wind and allows sufficient clearance at 32 deg. Fahr. with ground wire loaded and conductor unloaded.

Composite modulus of elasticity = 12,000,000.
Composite coefficient of expansion = 0.0000105 per deg. Fahr.
Weight of wire = 29 lb. per foot.

A satisfactory solution of this problem has been worked out, based on a comparison of unstressed length of conductor. By unstressed length of wire is meant the length of wire under the condition of no external stress acting on it. Stated another way, unstressed length of wire in a span is the actual length measured along the curve taken by the wire when in place, less the elongation due to the stress in the wire. It will be noted that unstressed length varies with the temperature. The basis for a formula for a tension suitable to the conditions outlined before is as follows: The stringing tension for any section of line between dead ends should be such that the total unstressed length of conductor in the section is equal to the length that would be the sum of the unstressed lengths in the component spans if each of these could be strung independently to the theoretical tension.

Procedure in Determining Stringing Tension

Once a section of line has been strung, there is for that section, at any one temperature, a fixed and invariable unstressed length of wire which depends upon the unstressed length at stringing temperature, the temperature coefficient of expansion of the wire and the change in temperature from the stringing condition to the one in point. The unstressed length taken in conjunction with the loading determines the deflection and tension. That this is true is shown very clearly by the method of sag-tension calculation given by Lyndon in his "Hydroelectric Practice." Having given a span at a temperature and loading different from the stringing conditions, the unstressed length at the new temperature is found as just outlined. A value for the unknown stress in the wire under the new conditions is then assumed. The elongation, total stressed length of wire and consequent deflection in the wire are then computed. The stress corresponding to this deflection must be the same as that assumed, or the computation must be repeated with a new assumed stress. Coming back to our problem, it is evident that in the case of any given section of line it is the unstressed length of wire in the section, together with the characteristics of the wire itself, that determines the tension and deflection under any given set of conditions. Hence it is necessary only to determine what unstressed length at stringing temperature gives the desired tension on maximum load and to string the section as a whole to that unstressed length.

Short Cut by Using Equivalent Span

It is evident that the stringing tension for a given section will have a value between the curve tensions for the longest and shortest spans in the section. By

means of a cut-and-try method the following simple formula was determined upon: The stringing stress for a given section of line between dead-ends shall be the stress given by the stringing curve for an "equivalent span" the length of which is equal to the average of all spans in the section plus two-thirds of the difference between the length of the longest span and the average span length. Thus:

$$L_{equiv} = L_{av} + \tfrac{2}{3}(L_{max} - L_{av}), \text{ where}$$

$$L_{av} = \frac{l_1 + l_2 + l_3 \cdots + l_n}{n}$$

This empirical formula gives results correct within the degree of accuracy obtainable in the actual stringing of the wire, as shown in the following example:

Assume a section of line as follows: Three suspension structures between a pair of dead-end structures; span lengths, three of 300 ft. (90 m.), and one span of 700 ft. length; conductor No. 4/0 steel-reinforced aluminum; maximum loading, Class B, *i.e.*, 8 lb. (39 kg. per sq.m.) wind and ½ in. (1.27 cm.) ice at 0 deg. F. (—18 deg. C.); maximum safe stress in the conductor, 4,000 lb. (280 kg. per sq.m.)

The tabulation gives for each span the stringing stress at 80 deg. Fahr. (27 deg. C.), and the unstressed length of wire in each span at 80 deg. Fahr. for three different methods or conditions of stringing:

STRINGING STRESSES, ETC., AT 80 DEG. FAHR.

Method	Span Length, Feet	Stringing Tension, Lb.	Stringing Sag, Feet	Stressed Length, Feet	Unstressed Length, Feet
a	300	1,220	2.67	300.063	299.941
b	300	880	3.72	300.125	300.035
c	300	1,010	3.23	300.093	299.990
a	700	863	20.50	701.600	701.398
b	700	880	20.20	701.550	701.344
c	700	1,010	17.60	701.180	700.944

TOTAL UNSTRESSED LENGTHS IN WHOLE SECTION

Method	Unstressed Length, Feet
a	1601.221
b	1601.449
c	1600.914

In method (a) each span is considered as isolated from the others and strung with theoretical correctness, as outlined in the first part of the paper.

In method (b) the section as a whole is strung to the tension for the "equivalent span"; *i.e.*, 600 ft. (180 m.) in this case.

In method (c) the section is strung as a whole to the tension for the average span; *i.e.*, 400 ft. (120 m.) in this case.

Since the formula for the tension for the "equivalent span" is an empirical one, it is not to be expected that in all cases the total unstressed length, and therefore the stress under maximum loading, given by method (b) will check the correct and exact values given by the theoretical computation (a) as closely as in the example given. It will be seen that the stringing tension for the average span is only slightly greater than the tension for the equivalent span. In fact, the dynamometer in stringing might easily introduce a greater inaccuracy than would enter by stringing by method (c). Hence in many cases it is immaterial whether method (b) or method (c) is used; that is, the more obvious method of stringing the section to the tension for the average span may in many cases be safely used. Just what stress would exist in the above section if strung by method (c) does not admit of easy determination, it being very difficult to arrive at the adjustments in unstressed length that take place in the several spans as the temperature decreases and the wire becomes loaded.

It will be noted, however, from the stringing curve shown that there is a greater difference between the stringing tensions for two given span lengths at the lower temperature than there is at the higher temperatures. In stringing at the lower temperatures, therefore, and in other cases where there is considerable difference between the tensions for the average and "equivalent" spans, it is well to use the tension for the equivalent span. It is advisable for the office engineer, in preparing his table of stringing tensions and sags for his foreman, to investigate unusual sections of line with a view of determining whether or not the tension for the "equivalent span" can be used to good advantage.

The study of this problem established a correct and rational basis for stringing a number of spans of varying length in the same section. It also established the fact that while the usual method of stringing to the tension for the average length of span results in slightly overstressing the conductor, this latter method may in the majority of cases be used. It is just as easy, however, for the office engineer to give the construction foreman a table based on tensions for the equivalent span, and under some unusual conditions, such as a combination of up-hill work and varying span lengths, the tension for the equivalent span may give somewhat better results.

It might be well to add a word of explanation concerning the stringing curve shown. All spans strung according to this curve, or any section strung to the tension given by the curve for the equivalent span, reach a maximum stress of 4,000 lb. (280 kg. per sq.cm.) at class B loading. The curves are flattened at the 400-ft. (120-m.) point because it was not considered advisable or necessary to stress an isolated span to a tension greater than that given for 400 ft. It is merely a matter of chance that the curve at 120 deg. Fahr. (49 deg. C.) is parallel to the axis of span length.

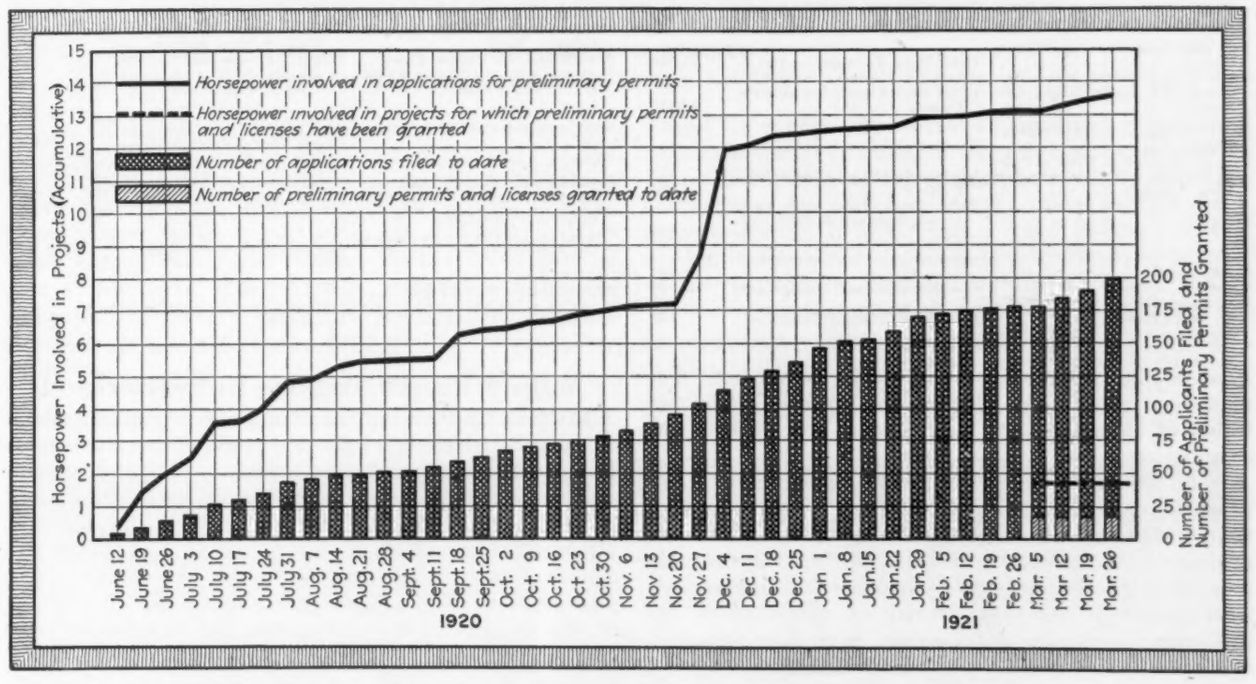
These methods of fixing upon the suitable tension for stringing a section of line containing widely varying span lengths were investigated as above outlined by the engineers of Francis R. Weller, Washington, D. C., in connection with the design and construction of an 88,000-volt tie line between the Logan and Sprigg plants of the Kentucky & West Virginia Power Company.

New "Stop-Water" for Joints in Concrete Dams

A RECENTLY designed "stop-water" for sealing joints in dams and other concrete structures has the novel feature of providing for renewal of the seal in case it is broken by settlement of the structure or other cause. The seal is made by asphalt in the form of blocks placed in a vertical groove during construction. Upon completion this asphalt is melted by passing steam through a pipe embedded in the blocks, thus allowing the hot asphalt to flow into and fill the joint. Should renewal of the seal become desirable at a later time, the asphalt is again melted, and if necessary more is added at the top of the column to replace that which, at the time of the second melting, may flow into the joint. The method has been patented by F. B. Smith of San Francisco.

Water-Power Applications Reach 200 Mark

Federal Power Commission Reports the Receipt of 200 Applications for Preliminary Permits Up to and Including March 26—Twenty-two Applications Were Filed with the Commission During March


Horsepower involved in applications for preliminary permits
Horsepower involved in projects for which preliminary permits and licenses have been granted
Number of applications filed to date
Number of preliminary permits and licenses granted to date
Horsepower Involved in Projects (Accumulative)
Number of Applicants Filed and Number of Preliminary Permits Granted
June 12 June 19 June 26 July 3 July 10 July 17 July 24 July 31 Aug. 7 Aug. 14 Aug. 21 Aug. 28 Sept. 4 Sept. 11 Sept. 18 Sept. 25 Oct. 2 Oct. 9 Oct. 16 Oct. 23 Oct. 30 Nov. 6 Nov. 13 Nov. 20 Nov. 27 Dec. 4 Dec. 11 Dec. 18 Dec. 25 Jan 1 Jan. 8 Jan. 15 Jan. 22 Jan. 29 Feb. 5 Feb. 12 Feb. 19 Feb. 26 Mar. 5 Mar. 12 Mar. 19 Mar. 26
1920
1921

PROJECTS INCLUDED IN APPLICATIONS FILED WITH THE FEDERAL POWER COMMISSION NOW TOTAL 13,536,431 HP.

MORE applications for preliminary power permits were filed with the Federal Power Commission during March than during any average month since the passage of the federal water-power act. Applications involving twenty-two projects were filed in March, involving a total of 386,085 hp. The latest data issued by the commission indicate that the net capacity of the 200 projects now on file totals 13,536,431 hp. The discrepancy between these figures and those previously published arises from the revision of figures where conflicts between certain large projects had occurred.

Of the applications filed during March, thirteen were for projects in California, three in Montana, and one each in Kentucky, Oklahoma, Utah, Missouri, South Carolina and Alaska. The largest project recorded during March was that of J. S. Wallace, involving three dams on the Cumberland River in McCreary, Pulaski and Whitley Counties, Ky., and totaling 160,000 hp. This was the only project involving more than 100,000 hp.

Table I gives a list of the applications for preliminary permits filed with the Federal Power Commission from Feb. 26 to and through March 26. Lists of applications filed prior to Feb. 26 appeared in the ELECTRICAL WORLD of Jan. 1, Jan. 15, Feb. 12 and March 12.

The work of the Federal Power Commission has now reached the stage of granting preliminary permits and licenses. During March sixteen preliminary permits or licenses were granted, one of which involved two applications. Six of these permits were for transmission lines, leaving ten hydro-electric projects which may be considered as almost certain of construction in the near future. These ten projects involve a total of 1,702,036 hp., and it is estimated that they will require an expenditure of about $1,975,000,000 for generating plant, transmission and service equipment. The largest of these projects is that of the Southern California Edison Company, involving five dams, four reservoirs and two power houses in the headwaters of the South Fork of San Joaquin River, California, with a possible waterwheel installation of 425,000 hp. Table II gives a list of the preliminary permits and licenses which have been granted by the Federal Power Commission.

At the sixteenth meeting of the Federal Power Commission, held on Feb. 28, the following applications for preliminary permits or licenses involving the use of the waters of the Niagara River were rejected: Project No. 6, Niagara Power & Development Company; project No. 14, Western New York Utilities Company; project No. 25, Niagara, Lockport & Ontario Power Company; project No. 26, city of Buffalo; project No. 37, J. K. Thomson et al.; project No. 39, M. F. Bowen; project No. 45, Niagara Gorge Power Company.

GROWTH IN APPLICATIONS FILED

The accompanying diagram shows the growth in the number and horsepower of applications for preliminary permits and licenses filed with the Federal Power Com-

TABLE I—LOCATION AND SIZE OF WATER-POWER PROJECTS FOR WHICH APPLICATIONS FOR PRELIMINARY PERMITS WERE FILED WITH THE FEDERAL POWER COMMISSION FROM FEB. 26, 1921, TO AND THROUGH MARCH 26, 1921

Name of Company	Location of Project	Capacity, Hp.
CALIFORNIA:		
Pacific Gas & Electric Co., 445 Sutter St., San Francisco	Transmission Line, Green Valley	.....
Pacific Gas & Electric Co., 445 Sutter St., San Francisco	Transmission line, Tahoe National Forest	.....
El Dorado Power Co., care Chickering & Gregory, Merchants Exchange Bldg., San Francisco.	South Fork American River.	39,735
Southern Sierras Power Co., care W. L. Huber, First National Bank Bldg., San Francisco	Willow, Vivian, Falls, Alder and Lost Creeks	800
Provident Irrigation Co., Willows, Cal	Deer Creek, Tehama County.	11,500
Little Rock Power & Water Co., Room 307, Delta Bldg., Los Angeles	Little Rock Creek, Los Angeles County	4,830
C. B. Johnson, care V. G. Preston, Bishop, Cal	Transmission line, Ingo County.	.....
City of Los Angeles, Dept. of Public Service, 603 Knickerbocker Bldg., Los Angeles	Big Pine and Baker Creeks, Ingo County	8,000
Same	Rock Creek Lake and Rock Creek, Inyo and Mono Counties	6,000
Same	Sawmill and Division Creeks, Inyo County	1,300
Same	Cottonwood Creek, Kern County	4,950
Rich Point Mining Co., 57 Tevis St., San Francisco	Bear Creek, Plumas County	360
CALIFORNIA:		
Yuba Development Co., 1213 Hobart Bldg., San Francisco	No. Fork of Yuba River, Sierra and Nevada Counties	76,500
KENTUCKY:		
J. S. Wallace, care Chas. H. Gunter, The Annex Hotel, New York City	Cumberland River in Kentucky.	160,000
MISSOURI:		
H. S. Shaner, Eminence, Mo.	Current River	5,000
MONTANA:		
R. T. Ringling, White Sulphur Springs, Mont	Willow Creek, 6 miles from White Sulphur Springs	400
Fred Mielde, Livingston, Mont.	Republic Creek, Park County	220
Boston & Montana Milling & Power Co., Butte, Mont	Transmission Line, Lewis and Clark National Forest	.....
OKLAHOMA:		
Sand Springs Home, Sand Springs, Okla	Grand River, Rayes County	55,000
UTAH:		
United Power & Light Co., care Charles Demoisey, Vernal, Utah	Pole Creek and United River Duchesne County	6,500
SOUTH CAROLINA:		
Columbia Railway & Navigation Co., Columbia, S. C.	Santee and Cooper Rivers	5,000
ALASKA:		
Cooper-Harbor Pulp & Paper Co., care T. A. Kelley, Bank of Nova Scotia Bldg., Vancouver, B. C.	Reynolds Creek, Prince of Wales Island	5,000

mission since the passage of the water power act. The number of applications filed has far exceeded the expectation of those who are interested in the work of the commission.

It is estimated that with the present force of engineers on the staff of the commission it will take some four or five years to investigate and report on all these projects in an efficient manner. During the first ten months of the commission's existence 200 applications were received, and only seventeen applications for preliminary permits and licenses have been granted, and six of these were for transmission lines.

COMMISSION ENGINEERS HAVE GIGANTIC TASK AHEAD OF THEM

The field investigation and making of reports will move along much faster now that the regulations and schedules have been fully worked out, but the task before the commission is a gigantic one. During the month of February it looked as though the filing of applications had about ceased, or at least would continue at the rate of only two or three per week, but during March the new filings were again increased to an average of about six a week.

How long the filing of applications will continue remains to be seen.

Winter Power Stations in Switzerland

PROMINENT among the winter power stations which large Swiss electric light and power corporations have been led by the unusually dry winter of 1920-1921 to consider erecting is one in the Wäggi Valley in the Canton of Zurich. This project is attracting great attention in all parts of Switzerland. At a recent meeting of the Zurich Chamber of Commerce the president of the Northeastern Swiss Power Works said that on account of the steadily increasing demand for electrical energy the lack of winter power had been intensively felt and that for the Northeastern Power Works alone the deficiency during the winter months in the next four or five years will reach at least 50,000,000 kw.-hr. The Wäggi Valley power house, which the company intends building with the financial support of the city of Zurich, will supply 110,000,000 kw.-hr. A concession for this station has already been granted. The cost of its construction, including all necessary electrical machinery, etc., will amount to 94,000,000 francs; that is to say, 1 kw.-hr. will cost 7.6 centimes. This price is considered a little high at present, but the market price for winter energy is still higher. Work on the new plant will be started early in the spring of this year, and it is expected that by the end of 1924 the station will be in operation.

TABLE II—LOCATION AND SIZE OF WATER-POWER PROJECTS FOR WHICH PRELIMINARY PERMITS OR LICENSES HAVE BEEN GRANTED BY THE FEDERAL POWER COMMISSION

Name of Company	Location of Project	Capacity, Hp.
ARKANSAS:		
Dixie Power Company, Title Guaranty Bldg., St. Louis, Mo.	White River	100,000
CALIFORNIA:		
Southern California Edison Co., Edison Bldg., Los Angeles	Big Creek, Fresno County	120,000
Southern California Edison Co., Edison Bldg., Los Angeles	South Fork San Joaquin River, Fresno County	425,000
Luther Hill, Independence, Cal.	Sam Mill Creek	386
Pitt River Power Co., care Harr and Bates, Westory Bldg., Washington, D. C	Pitt River	,000
Coast Valleys Gas & Electric Co., care Chickering & Gregory, Merchants' Exchange Bldg., San Francisco	Transmission Line, San Benito	.....
Southern California Edison Co., Edison Bldg., Los Angeles.	Transmission Line, Sequoia National Forest	.....
MONTANA:		
Amazon Dixie Mining Co., Wallace, Idaho	Transmission line, Lolo National Forest	.....
MONTANA:		
Butte-Jardine Metals Mining Co., care C. R. Leonard, Butte, Mont.	Transmission line, Deer Lodge National Forest	.....
NEVADA:		
Spanish Belt Silver Mining Co., 629 Nicholas Bldg., Toledo, Ohio	Transmission line, Nye County.	.....
NEW YORK:		
Hydraulic Race Co., Lockport, N. Y.	Niagara River	5,000
Niagara Falls Power Co., Niagara Falls, N. Y.	Niagara River	400,000
Lower Niagara River Power & Water Supply Co., care H. L. Cooper, 101 Park Ave., N. Y. C.	Niagara River	250,000
Ford Motor Co., Dearborn, Mich.	Green Island, Hudson River	8,250
NORTH CAROLINA:		
United Mills Co., Hickory, N. C.	Harper's Creek, Caldwell Co.	1,400
SOUTH DAKOTA:		
Paving Granite Quarry Co., Rapid City, S. D	Transmission line, Black Hills, National Forest Reserve	.....
WASHINGTON:		
Washington Irrigation & Development Co., care Electric Bond & Share Co., 71 Broadway, N. Y. C.	Columbia River	300,000

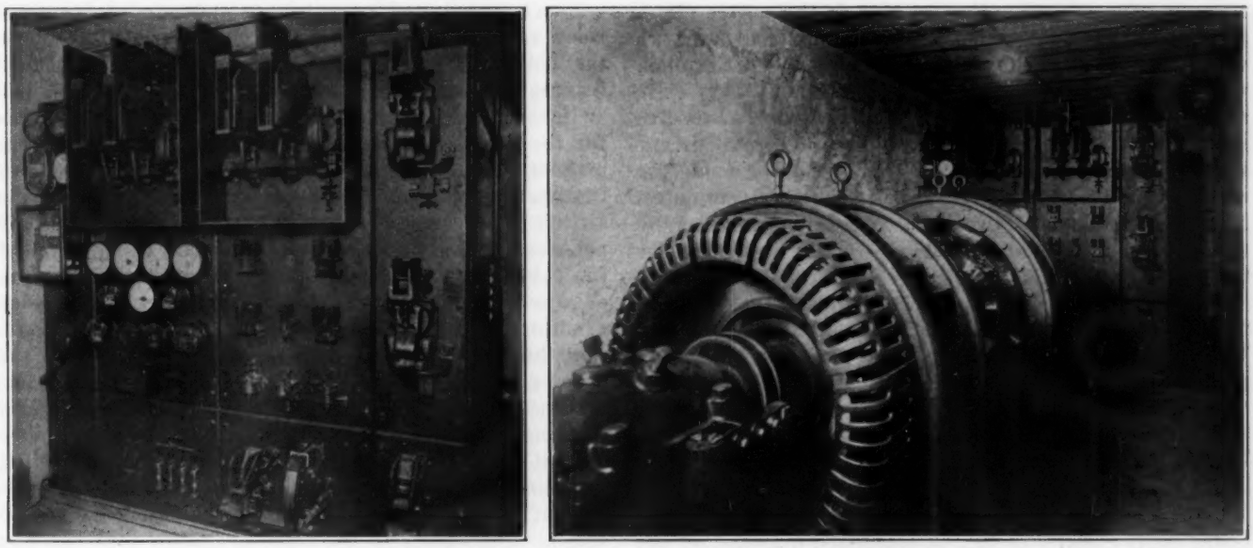
Mine Substation Operates Automatically

Underground Substation Automatically Aids Steam Generating Station at the Mouth of Mine in Maintaining Voltage Regulation—System Adopted May Be Used for Rotaries or for Motor Generator Sets

By GRAHAM BRIGHT
General Engineer Westinghouse Electric & Manufacturing Company

AUTOMATIC substations offer interesting possibilities as a solution for the distribution problem connected with the electric haulage system in mining work, particularly in those cases where feeder capacity is not sufficient to give good voltage regulation. Owing to the low operating cost as compared with manually operated stations, the automatic substation appears to deserve the study of every mining electrical engineer confronted with this problem.

So far as is known, the installation recently placed in operation by the Lincoln Coal Company of Nanty Glo, Pa., is the first of its kind. This mine is of the drift type with a main-line haul of more than 2 miles (3.2 km.). Power is generated by a 250-volt direct-current generator belted to steam engines at the drift mouth. The grade is against the loaded trip for the entire length of the main haul, so that even with a fair amount of feeder capacity the voltage near the working places was, before the substation installation, very low when the trip was being made.



AN APPLICATION OF THE AUTOMATIC SUBSTATION TO MINING WORK
On the left is shown the control equipment and on the right a general view of the substation recently installed by the Lincoln Coal Company at Nanty Glo, Pa.

As the Penn Central Power Company has a power line running over the property, it was decided to install a substation in the mine near the working places. Charles Stuart of Stuart, James & Cook acted as consulting engineer for the coal company and decided to install an automatic substation to provide the needed relief at a minimum operating cost. The converting set installed is a 200-kw. synchronous motor-generator set, and the entire substation equipment has been operating successfully since its installation. Before the substation was placed in service the operating conditions were very unsatisfactory. It required forty-five minutes to bring out a loaded trip of thirty cars, and during this time the voltage was very low for the other electric equipment operating in the mines. Since placing the substation in operation a round trip with the same number of cars is made in eighteen minutes and good voltage regulation is obtained at all time in various parts of the mines with a consequent speeding up of all operations.

The output of the mine has been increased 200 tons per day, which represents a fairly high percentage for a mine whose yearly production has been 150,000 tons. The good voltage regulation inside of the mine should greatly decrease the upkeep and repairs on all electrical equipment, since one of the most prolific causes of high upkeep and repair expense is poor voltage.

The substation is installed 2 miles from the drift mouth, and the room consists of a dry, well-ventilated and well-lighted underground chamber about 10 ft. x 30 ft. (3 m. x 9 m.) in size. The walls are built of heavy masonry with concrete reinforced with steel beams for the ceiling. The inside walls are cement-plastered. The 2,200-volt cable comes down from the surface through a bore hole just outside of the substation. The entire substation is built and the equipment is mounted in a most substantial manner which will insure long life and low maintenance.

One illustration shows the automatic control equipment. The main oil switch, resistance grids and some of the relays are installed back of the switchboard panel. The three large switches to the right are the resistance

contactors to cut in resistance when the load becomes too great, while the contactor at the bottom in the center is the main direct-current switch and is controlled by an alternating-current magnet. The large high-voltage contactors at the top are for starting the motor-generator set, the one on the right being the starting switch and the other the running switch. The main oil circuit breaker, auto-transformer and resistor are located back of the panel. In the center are the various relays and meters. To the left is an incoming alternating-current panel with graphic, indicating and integrating meters as well as overload relays.

Automatic substation equipment is designed to operate with either rotary converters or motor-generator sets. About the only difference between the two is that the rotary requires a brush-lifting device, if of the commutating-pole type, and a polarized relay to take care of the rotary coming into step with the direct-current voltage reversed.

At present the substation is started and stopped by a small control switch operated by the first man to enter the mine in the morning and the last man out in the afternoon. However, the substation can easily be made entirely automatic by throwing the double-throw control switch in the other direction, or it can be started and stopped from a push-button station in the power plant. Under automatic operation the substation will start up when the trolley voltage goes below a predetermined value for a period longer than five seconds. The set is started up and placed on the line in about twenty-five seconds, and it stays on the line until the direct-current load is reduced below a certain predetermined value for a period of time ranging from three to thirty minutes. Heavy direct-current overloads are taken care of by automatically inserting resistance in the direct-current feeder circuit. This lowers the substation voltage and shifts some of the load to the steam plant. As soon as the overload is reduced the resistance grids are cut out. If the overload persists long enough to heat up the grids to a dangerous temperature, a thermostat will shut down the substation. As soon as the grids have cooled down, the station will start up again if voltage conditions require it. If necessary, this scheme can be changed and an automatic reclosing breaker can be substituted. This may prove more satisfactory in mines where frequent short circuits occur. A continued overload on the generator or rotary will cause the substation to shut down until the set has cooled, when it will automatically start up again if required.

Machine Will Shut Down if a Hot Bearing Develops

As the bearings of the motor-generator set or rotary are equipped with thermostat relays, the set will be shut down if a hot bearing develops and will not start up again until the thermostat is reset by hand, thus insuring that attention will be given the bearing before operation again begins.

Automatic control might be elaborated on, but only the simple and necessary features are recommended for mine service. Such characteristics as the following have made the new substation equipment popular and a practical success: First, the equipment duplicates in every way the manual operation of substation apparatus. Second, each switching operation is a direct function of the electrical condition of the converting apparatus at that particular moment. Third, each succeeding switching operation is dependent upon the proper functioning of the preceding operation. Fourth, at no time is any switching operation dependent upon any mechanical time element or mechanical sequence of operation. Fifth, none of the time elements used with various relays are of the oil dash-pot type, but they are especially designed to be unaffected by wide variations in temperature. Ordinarily, a substation without an operator would not be heated, and at extremely low temperatures oil dash pots may become inoperative. Sixth, the entire equipment consists of an assembly of proved apparatus. The majority of the magnet switches and relays have demonstrated their quality in steel-mill control work.

Scheme of Operation

Substations without attendants may be made to start automatically in a number of ways depending upon conditions to be met, but for the most part they function through the agency of some form of remote control, or automatically by means of a voltage relay which closes its contacts at some predetermined value of reduced trolley voltage. In starting a synchronous converter, circuits thus set up cause other control relays to function in such a way as to close the oil circuit breaker, the normal field switch and the alternating-current starting switch.

Synchronism and polarity are indicated by a polarized relay which, in case of reverse polarity, causes the polarity of the machine to be corrected by field reversal accomplished by normal and reverse field switches opening and closing automatically. The control for the field switches consists of a small direct-current magnet switch energized from the direct-current end of the converter through contacts made on a small drum switch driven in a counter-clockwise direction by the polarized motor. Just here it must be explained that the field of the polarized-motor relay is fixed by means of a permanent magnet, while the polarity of the relay armature becomes that of the machine for the reason that during starting it is directly connected across the direct-current terminals of the converter. It is thus obvious that the relay armature will not rotate until the machine has pulled into step since prior to synchronism it is receiving alternating current of a diminishing frequency, the value of which becomes zero at the instant the converter armature reaches synchronous speed. The supply to the relay armature thus becomes direct current, causing it to rotate in a direction dependent upon the polarity of the machine. It must also be understood that when the field of a synchronous converter is reversed the voltage at its commutator falls to zero. So it may now be understood that the reverse field switch remains closed only for the instant required for voltage to fall to zero and release the control relay. Immediately normal field is re-established by the closing of the normal field switch; the machine has slipped a pole, thus correcting the polarity. The polarized relay now runs in a clockwise direction, setting up circuits on the drum switch in such a way as to cause the alternating-current starting contactor to open and the alternating-current running contactor to close. Then through interlocks, which are closed in proper sequence, the brushes are lowered to the commutator by a motor-driven device and the direct-current switches close. This connects the machine to load through current-limiting resistance, which is then shunted in steps by switching closed through the functioning of accelerating relays. The machine remains in operation until cut out of service by the light-load control.

Protection is provided by induction-type single and polyphase relays which prevent the station from starting under any abnormal conditions of alternating-current line voltage, such as low voltage, open phase or reverse phase. This same type of relay causes the station to shut down on unbalanced phase conditions. If the trouble is inside of the station, a lockout relay prevents restarting, while if the unbalanced phase condition is outside of the substation, the automatic equipment will function to bring the apparatus into service as soon as the line is restored to normal.

Bearings are equipped with thermostats which in the case of a hot bearing lock the machine out of service until the contacts of the thermostat device have been reset by hand.

A thermal relay protects the machine from overheating on overload.

A direct-current reverse-current relay, an overspeed device, induction-type alternating-current overload relays, a thermostat to prevent overheating of the direct-current current-limiting resistance and a look-out relay which locks the equipment out of service in case of failure of any part of the apparatus are other protective features.

The protection furnished by the equipment is complete, and it responds immediately in case of trouble, thus eliminating the losses which often occur in manually operated substations owing to the inability or impossibility of an operator to handle an emergency.

Substations with Two or More Units

The control for stations equipped with two or more units is so designed that after a load exceeding a given value has been maintained for a predetermined period of time another machine is automatically connected to the load. In case of failure of one machine another machine starts and picks up its share of the load. If in starting the first unit fails to take load within two minutes after the control receives the starting impulse, the second machine starts and the first is locked out of service. A signal connected with the lockout relay gives notice of the failure. This signal may be by pilot wires to some distant point, or it may be a signal which is visible to the motormen on trips passing the station.

To obtain a clear conception of the operation of an automatic substation let us assume a fairly large mine the workings of which have developed to such an extent that satisfactory voltage regulation cannot be obtained by a reasonable installation of feeders. It is decided to install an automatic substation inside of the mine containing two rotary converters.

The substation lies idle during Sundays, holidays, and in fact all the time that there is no demand for power. At about 7 a.m. the men start coming into the mine, and in a short time a main-haulage locomotive picks up a loaded trip and starts for the drift mouth. The ordinary night load caused by cutting machines, pumps and one or two gathering locomotives does not cause a sufficient drop in voltage to start the substation. The main-haulage locomotive will, however, cause a decided drop in voltage. This fact is immediately telegraphed to the substation, where a low-voltage direct-current relay receives the message. If the call for power is only momentary, lasting but two or three seconds, the rotary will not begin operation. If, however, the heavy call for power persists for five seconds or more, then the rotary is started up, correction for wrong building up of voltage is made if necessary, the brushes are let down on the commutator at the proper time, and in less than thirty seconds the rotary is helping to its full capacity.

If the load is of short duration, the low-current relay will operate and shut the rotary down. The same thing is repeated when a second trip starts to the drift mouth. As soon as rotary No. 1 starts up rotary No. 2 stands ready to help out with the load. If the load becomes too heavy for rotary No. 1, a load relay causes rotary No. 2 to get ready, and if the heavy load persists, rotary No. 2 starts up and operates as long as the heavy load lasts.

Resistance Inserted in Line in Case of Overload

Sometimes a combination of circumstances arises which makes the load too heavy for both rotaries. This may be due to a motorman trying the destructive scheme of starting a very heavy trip with sand on the track and his brakes screwed up. In this case a load relay causes resistance to be inserted in the circuit, which reduces the voltage and shifts some of the load to the power plant or other substations. This is done in one, two or three steps, depending upon the severity of the overload. If this does not produce results, the resistance will stay in the circuit until it becomes as hot as is safe and then a thermal relay operates and opens up the circuit and shuts down the substation. As soon as the grids have cooled to a definite temperature the substation will start up again with one or two rotaries as the load conditions may require.

One or both rotaries will operate until the lunch hour, when both will shut down until the afternoon work begins. Some of the feeders may be equipped with automatic reclosing circuit breakers. Where frequent short circuits occur this is a better scheme than the resistance relay, as explained above. With the automatic reclosing breaker a very heavy load or short on a feeder will cause the breaker to open, and it will remain open until the short or overload is removed.

Thermostat Protects Bearings

If a rotary develops a hot bearing, the bearing thermostat—there is one on each bearing—does not wait until any real damage is done but promptly shuts down the machine and the other rotary takes over the load. The thermal relay also can be arranged to bring a maintenance crew by operating lamp or bell signals installed at some point whence help can be summoned by telephone. In a short time the bearing receives attention and the substation is once more in normal condition. At quitting time the station shuts down, and it remains in this condition until called upon the next working day by the load condition in the mine.

If the alternating-current voltage drops below a certain value at any time or if one phase of the power system is opened, the substation will shut down until normal conditions are re-established. The substation equipment is always awake when power is available and always does the right thing at the right time, instantly making the proper decision and affording full protection to the equipment at all times.

The automatic substation should not require an inspection more often than once every two weeks and the saving in substation attendants will in most cases pay for the increase in first cost and more than compensate for the additional capital investment.

How 3,000 Southern Homes Were Wired—II

Method of Making the Preliminary Sales Canvass—Results Derived from the Campaign Estimated by Months—Cost of Obtaining Contracts—Essentials of a Successful House-Wiring Campaign

By L. J. WILHOITE
Lighting Contract Agent Chattanooga Railway & Light Company

DETAILED description of laying out the sales plan, preparing advertising material and selecting and training salesmen, leading up to the preliminary survey, was given in the first section of this article on page 645 of the ELECTRICAL WORLD for March 19. In this concluding portion of the article the results of the campaign, cost per contract and interesting points connected with the house-wiring business are related.

In starting the sales canvass the following instructions were given: "We are now ready for the preliminary survey. Take no contracts for two weeks and as long thereafter as it requires you to complete a canvass of your respective districts. Take everything that looks like a 'prospect,' and if in doubt give the person living there the benefit. Don't waste any time—you can't afford it for you are on starvation wages until you finish this preliminary job. Get the information and get away. Leave a house-wiring booklet and a return post card in your wake. Let the booklet do the talking and save your voice for more strenuous business later on. The sooner you finish this preliminary canvass job the sooner you will get in the money-making class, and the more thoroughly you do it the bigger the income will be when you get there. Remember, the first man fooling away his time signing a wiring contract is fired—that's all."

The way those men swamped the follow-up clerk during the next two weeks was good to see. In two weeks 1,982 prospective customers had been reported, but only two salesmen declared their districts finished. These two men were then put into unfinished districts, and the canvass started into the third week. At this point we said: "If you fellows don't get this job through, you are going to starve to death; so get a move on you, ring some door-bells." By Saturday night 1,242 reports were in, making a total for three weeks of 3,224. The following Monday morning each man stood up and declared that he had counted every nose in his district. We had our doubts because we were short 842, since our original calculation called for about 4,066 availables. However, we had all the information that any direct-by-mail expert could work on—3,224 good "prospects."

As a result of the canvass, supplemented by the newspaper advertising that we had been carrying, a few contracts had been taken at our office and at the contractor's office. Further, several post cards that the salesmen had left while making their canvass had begun to come in, all of which we had discreetly kept under cover during the preliminary canvass. The crediting of these contracts to the men from whose districts they had come, and the passing out of the inquiries received, acted as a good stimulant the first day of real selling effort. The first month's start was good, and on April 30 we had a total of 303 contracts. At the end of that period two of the men gave up the work, while a third begged for more time. We slowed up slightly and started the second month with a crew of five, splitting up the vacant districts among those remaining. The men who finished their house-wiring career so quickly were the very ones who went through the preliminary canvass most smoothly, easily and dashingly.

RESULTS OF CAMPAIGN BY MONTHS

About the second half of the second month the number of contracts started to slump. The independent contractors began knocking the props from under our predetermined price schedule. They were poking fun at the Edison plan by advertising it, and "wildcat" wiremen were combing the town for business. It looked as if every wiring contractor in town had suddenly come to the conclusion that his only salvation lay in increasing the volume of his old-house-wiring business, and as usual the only way he could figure out to increase the volume was to cut the price. In a very short while the prices we were quoting were considerably above the current level. What with independent contractors, the "wildcat" wiremen and the "prospect's" determination not to wire his house now, it looked pretty gloomy for the Edison plan. On May 31 we wound up with a total of 138 contracts for the month. On June 1 things looked blue, and we were debating what to do with our sales force. We believed that it was not altogether the fault of the men and made a modification of our plan. This included an offer to give two months' energy to anybody signing a contract for wiring an old house before June 30. We made it plain that 300 house-wiring contracts must be taken during that month or the house-wiring sales department would terminate from that time on. The way those salesmen passed out free energy must have made the "prospects" forget the conditions, for they frequently called us up to thank us. The contractor doing the work for us was snowed under with orders, and we wound up on June 30 with 319 old-house-wiring contracts.

The morning after we issued the following notice: "Fellows, your jobs are safe and we have a picnic coming. Everybody is tired and has a right to be. So we are off duty until the tenth—no daily report and no regular time to get up in the morning." We had the picnic and the ten days without reports, and that's where we made a mistake. The picnic and ten days with no alarm clock, coupled with good commissions the month before, were too much prosperity for a couple of salesmen and they slumped in July. But we are glad to add that they succeeded in coming back the following month.

The total for July with two men out was 269, one man securing 137 contracts, which is the best one-man house-wiring record that we have ever had the pleasure of marking up. In August, with no special inducements, the record was 258. One of the salesmen fell down that

Return Post Cards and Free Premium Coupons Used to Stimulate the "Edison Home Wiring Plan"

THESE PREMISES
ARE EQUIPPED FOR THE USE OF
ELECTRIC LIGHT
FURNISHED BY THE
CHATTANOOGA RAILWAY AND LIGHT COMPANY
Phone Main 5900
AND CURRENT WILL BE TURNED ON PROMPTLY

1

What Has Your Landlord Given You IN RETURN FOR YOUR RENT MONEY?

Has he given you full value for your money in the form of a convenient, comfortable, modern home, or has he given you just a house? Answer this question frankly. Ask yourself if your rent money doesn't entitle you and your family to a real, comfortable, modern place to live in. You know that no home can be called modern or convenient that isn't wired for electric light.

Landlords know that an unwired home isn't modern. They know that the most desirable tenants won't rent a home without electric light. That's why hundreds of them are wiring their properties.

Have you asked your landlord to wire your home? He can no longer dodge the issue on the plea that he can't afford it. Our special home wiring plan enables him to wire your home without one penny in advance and on easy monthly payments without interest.

You and your family deserve this convenience—so let's get it. Send us your landlord's name on the attached postal, and we'll explain our plan to him. Do this TODAY.

—LET US HELP YOU WIRE THAT HOME—

Chattanooga, Tenn. ..... 191....

Gentlemen:—

I would like to have electric light in my home, but I am renting, and the house is not wired. Without obligating me in any way, you may explain your wiring plan to my landlord.

His name is.....

His address is.....

The agent is.....

My name is.....

My address is.....

I have lived here about.....Years.....Months

Remarks .....

2

Reply Card

PLACE ONE CENT STAMP HERE

Chattanooga Railway & Light Company

Chattanooga,

Tennessee

EDISON
Home Wiring
Department

3

The Easiest Way to Pay for a Lifetime of Joy

Gentlemen:

Our home is not wired for Electric Lights. You may send your representative to give prices for wiring and to explain the new

Edison Easy Payment Home-Wiring Plan

It is understood that this request places me under no obligations whatever and is made merely to ascertain the details of your wiring plan and the cost of wiring our home.

Sincerely,

Name _____

Address _____

Remarks _____

PLEASE MAIL THIS CARD NOW WHILE YOU THINK OF IT — "LEST YOU FORGET"

4

THIS COUPON VOID

UNLESS PRESENTED ON OR BEFORE WEDNESDAY OCTOBER 15TH, 1919. AND IS FOUND TO COMPLY WITH THE FOLLOWING REQUIREMENTS —*

*COUPON MUST BE COMPLETELY FILLED OUT AND ENDORSED BY DISTRICT AGENT AT TIME OF PRESENTATION TO PARTY NAMED ON OTHER SIDE

*WIRING CONTRACT MUST COVER THE WIRING OF AN ALREADY BUILT HOUSE LOCATED ON THE COMPANY'S EXISTING LINES.

*LIGHTING CONTRACT MUST COVER PREMISES DESCRIBED IN THE WIRING CONTRACT

*WIRING MUST BE COMPLETED AND SERVICE CONNECTED, UNLESS COMPANY IS UNABLE TO COMPLETE CONNECTION ON OR BEFORE OCTOBER 15TH, IN WHICH EVENT COUPON MUST BE PRESENTED FOR APPROVAL IMMEDIATELY UPON COMPLETION.

*COUPON IS VOID IF PARTY TO WHOM ISSUED HAS PREVIOUSLY PRESENTED A LIKE COUPON FOR APPROVAL OR IS A PERSON OTHER THAN THE ONE DESIGNATED AS SIGNATORY TO EITHER THE LIGHTING OR THE WIRING CONTRACT.

*COUPON MUST BE APPROVED BY COMPLETION OF ENTRIES BELOW AT TIME OF PRESENTATION AT OFFICE.

WIRING CONTRACT NO. ..... SERVICE COMPLETE W.O. No. .....

APPROVED ..... L. C. AGT. PREMIUM RECD. ..... 191...

5

THE EDISON HOME WIRING PLAN PREMIUM COUPON

GOOD FOR
ONE STANDARD SIX POUND IRON
IF PRESENTED
ON OR BEFORE WEDNESDAY OCTOBER 15TH, 1919.
AT OUR OFFICE, 620 MARKET STREET, IN COMPLIANCE WITH THE REGULATIONS PRINTED ON THE REVERSE SIDE AND APPROVED AS STIPULATED.

ISSUED TO _____ ADDRESS _____

ACCOUNT OF WIRING CONTRACT FOR NO. _____

WIRING CONTRACT SIGNED BY _____

ACCOUNT OF LIGHTING CONTRACT FOR NO. _____ STREET

LIGHTING CONTRACT SIGNED BY _____

SIGNED _____ DISTRICT AGENT _____ 191__

CHATTANOOGA RAILWAY & LIGHT CO.

6

FREE PREMIUM CARD

Chattanooga Railway & Light Co. Date..... 191....

Gentlemen: I am going to try to get the landlord to wire our home, with the understanding that if I succeed I am to receive one $4.50 ELECTRIC IRON FREE as soon as the electricity is turned on.

Name..... Address.....

Landlord's Name..... Address.....

Remarks: .....

NOTE—Please keep the enclosed Free Premium Coupon till your home has been wired and the current turned on, then present it at our office and the $4.50 Electric Iron will be given you absolutely free. This offer limited to 30 days from date.

FILL OUT AND MAIL OR SEND THIS CARD TODAY

7

1. Doorknob reminder left by meter man when he removed the meter from a vacated house.

2 and 3. Return post card sent to tenants of unwired houses. This provided an effective entering wedge for the salesman when he interviewed the landlord.

4. Return post card addressed to owners of unwired houses.

5 and 6. Form of premium coupon and conditions under which it was good for an electric iron. This was offered to property owners for a limited period as an added inducement to sign the wiring contract then and there.

7. Premium card sent to tenants to enlist their assistance in persuading landlords to wire old houses.

month and we put him in our appliance department, where he made good immediately. He has since become district manager for a large company, and it was with considerable regret that we released him.

In September we used a couple of hundred flatirons that we had bought at a bargain and which, like most bargains, did not turn out well as a selling proposition. These we turned over to the four salesmen left to use as an added inducement to close house-wiring business. In dividing them up and turning them over to the men we cautioned them not to give everybody one of the irons, because the supply was limited and what they ought to do was to use them as an inducement with those inclined to hang back. They proceeded in such instances to make the flatiron a sort of personal token of appreciation for signing a contract then and there. The four salesmen and the 200 irons brought in 305 contracts for the month of September—one man winding up with 107 to his credit, the second highest record for one man in one month.

We opened October with only three men left and continued with these three up to Dec. 31. During the three months these three men took a total of 339 contracts, making a total for nine months ended Dec. 31 of 1,936 contracts. No advertising was done, nor was any special inducement of any kind offered during that time. This was on account of an unfortunate curtailment order that came along about Oct. 1. Most central-station business men can appreciate what we mean by a curtailment order and an enlargement on this point is not necessary.

As stated in the beginning, our goal for the first twelve months' campaign was set at 2,416 contracts. On Dec. 31, 1919, we had obtained 1,936 of these contracts after nine months' effort, leaving 480 to be taken in January, February and March, 1920, to complete the record. We fell down, however, as only 269 contracts were taken during these three months, leaving us short of our goal by 211 contracts. We should have made the quota had it not been for the fact that one of the salesmen had made so much money during 1919 that he felt impelled to get into business for himself and severed his connection with us on the first day of February. We were unable to replace him in time to reach the goal.

Cost of the Campaign

"But what did it cost?" It cost us just $7,124.48 less than we had originally figured it might possibly cost us to get 1,936 old-house-wiring contracts. We had figured it out that if necessary we could afford to spend $10.25 per contract. The actual cost was $6.57 per contract, making the total cost of the work from March 15 to Dec. 31 $12,756.40. As previously mentioned, $5 per contract went straight into the pocket of the salesman who secured the contract, while $1.57 per contract went to take care of clerical expense, advertising, etc.

"What is the business worth?" is the next question a central-station man is likely to ask. Pick out a straight road, line up on it 1,936 cottages, each on a 50-ft. lot, allow a cross street at the end of each city square, and you have a string of houses stretching about 17½ miles from end to end. We know of a man who owns a central station with less than half this number of consumers on its line and is making a very good living out of it. Anyhow, a string of homes like this ought to earn an average income of . . . , but that all depends upon the respectability of your rates and habits of the people in your town.

As a by-product of our efforts during the twelve months from April, 1919, to April, 1920, we had ascertained definitely the exact number of persons not using electric service in their houses. The number of white families living in houses near an existing line in our service districts and still continuing to deny themselves this privilege is 4,375, while the number of colored families is 4,981, making a total of 9,356. Of these however, 1,500 are so situated as to make it at present impossible to serve them, leaving 7,856 families accessible to our lines. Of course, a large part of this business is practically unavailable, and if it were available, would perhaps not be desirable. However, what constitutes desirable or undesirable residence business is a matter of which a discussion cannot be attempted in this paper. We felt safe in assuming that there were at least 4,000 persons in our districts still living in unwired homes that we must get wired up during the next two years at the longest. In view of this situation it was decided on April 1, 1920, to continue our house-wiring efforts as a permanent feature until we should reach as near 100 per cent saturation as possible.

Owing to the necessity of giving attention to commercial activities other than house wiring during part of 1920 and owing to the scarcity of competent salesmen only one man was regularly employed in house wiring, with a second man a part of the time. The number of house-wiring contracts secured from April 1 to Dec. 31, 1920, was 712. This, added to the total secured previous to that period, namely, 2,205, gives a total for the entire campaign of one year and nine months ended Dec. 31, 1920, of 2,917. Adding to these the contracts secured by independent wiremen places the total contracts over 3,000.

Roughly, our campaign efforts in old-house wiring during the nine months we were actively engaged during 1919 can be divided into three periods, characterized by the principal activities carried on during each one.

Cost per Contract Under Three Different Plans

The first period extended from April 1 to July 31 and may be referred to as the publicity period, inasmuch as during this time we engaged in much newspaper and direct-by-mail advertising. The total number of contracts taken during that period was 1,031; the average number per month was 258, and the average cost per contract was $8.03.

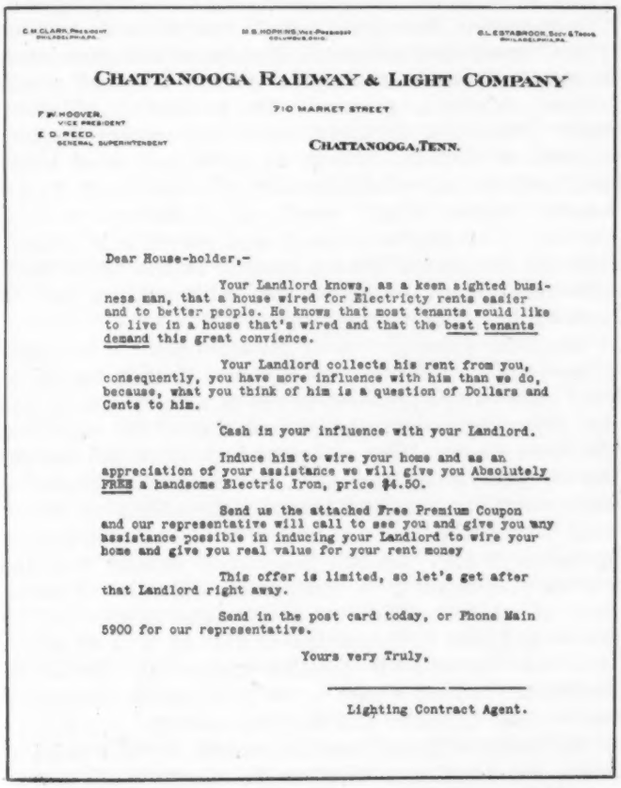
The second period extended from Aug. 1 to Sept. 30 and may be referred to as the free-premium period, inasmuch as during this time the only assistance given the salesmen was in the form of free electricity, as previously mentioned, and the giving away of a limited number of electric irons as premiums. All newspaper and other advertising was discontinued. The total number of contracts taken was 566; the average number per month was 283, and the cost per contract was $5.45.

The third period, extending from Oct. 1 to Dec. 31, may be styled the personal solicitation period, inasmuch as during this time no advertising was done nor were any special inducements offered. Dependence was placed solely upon the unaided efforts of the salesmen. The total number of contracts taken during this period was 339; the average number per month was 113, and the average cost per contract was $6.13.

From a study of results obtained during these three periods it is evident to us that if we had continued our advertising uninterruptedly until Dec. 31 we would have

secured 400 more contracts at an additional cost of approximately $3,200, or about $8 per contract. That is, an expenditure of $3,200 over and above what we actually spent—$1,200 for advertising and $2,000 commission to salesmen—would have added approximately 400 customers, producing an annual income of around $8,000. Of course, we hope to get this additional business some day; but we must confess that hope is not nearly so refreshing as the realization—all of which has proved to us—and we shall remain convinced until such time as somebody produces convincing arguments to the contrary—that it is downright hard-headed good business to advertise and keep everlastingly advertising.

Moreover, it might be interesting to note that contracts come cheaper and faster with a flatiron thrown in than they do without; that is, of course, if the flatiron is bought at a bargain price. Persistent advertising,



CHATTANOOGA RAILWAY & LIGHT COMPANY

710 MARKET STREET

CHATTANOOGA, TENN.

Dear House-holder,-

Your Landlord knows, as a keen sighted business man, that a house wired for Electricty rents easier and to better people. He knows that most tenants would like to live in a house that's wired and that the best tenants demand this great convience.

Your Landlord collects his rent from you, consequently, you have more influence with him than we do, because, what you think of him is a question of Dollars and Cents to him.

Cash in your influence with your Landlord.

Induce him to wire your home and as an appreciation of your assistance we will give you Absolutely FREE a handsome Electric Iron, price $4.50.

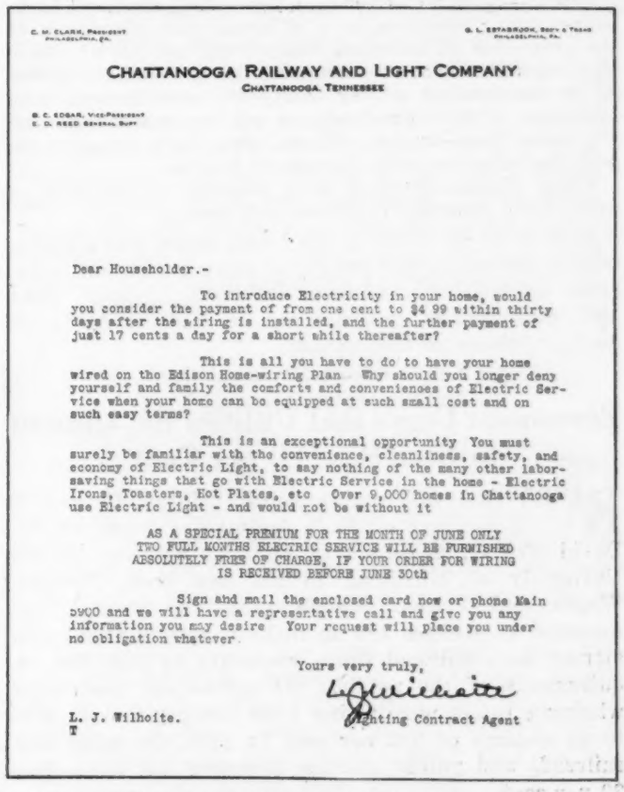
Send us the attached Free Premium Coupon and our representative will call to see you and give you any assistance possible in inducing your Landlord to wire your home and give you real value for your rent money

This offer is limited, so let's get after that Landlord right away.

Send in the post card today, or Phone Main 5900 for our representative.

Yours very Truly,

Lighting Contract Agent.



CHATTANOOGA RAILWAY AND LIGHT COMPANY
CHATTANOOGA, TENNESSEE

Dear Householder.-

To introduce Electricity in your home, would you consider the payment of from one cent to $4 99 within thirty days after the wiring is installed, and the further payment of just 17 cents a day for a short while thereafter?

This is all you have to do to have your home wired on the Edison Home-wiring Plan Why should you longer deny yourself and family the comforts and conveniences of Electric Service when your home can be equipped at such small cost and on such easy terms?

This is an exceptional opportunity You must surely be familiar with the convenience, cleanliness, safety, and economy of Electric Light, to say nothing of the many other labor-saving things that go with Electric Service in the home - Electric Irons, Toasters, Hot Plates, etc Over 9,000 homes in Chattanooga use Electric Light - and would not be without it

AS A SPECIAL PREMIUM FOR THE MONTH OF JUNE ONLY
TWO FULL MONTHS ELECTRIC SERVICE WILL BE FURNISHED
ABSOLUTELY FREE OF CHARGE, IF YOUR ORDER FOR WIRING
IS RECEIVED BEFORE JUNE 30th

Sign and mail the enclosed card now or phone Main 5900 and we will have a representative call and give you any information you may desire Your request will place you under no obligation whatever

Yours very truly,

L. J. Wilhoite. Lighting Contract Agent

TWO LETTERS OFFERING EXTRA INDUCEMENTS TO TENANTS AND PROPERTY OWNERS TO HAVE THEIR HOMES WIRED

together with special premium offers, particularly electric flatirons to house-wiring "prospects," serves as a wonderful nerve steadier to the house-wiring salesmen in the front line trenches.

ESSENTIALS OF A SUCCESSFUL HOUSE-WIRING CAMPAIGN

"But what have we learned from our efforts of the last year?" Here is what we have been able to put down as the A B C of the house-wiring business in so far, of course, as house wiring applies to Chattanooga, Tenn.:

First—Don't try to make wiring salesmen out of boys. Selling house wiring to gas and oil users is not a child's job—it is a man's job and requires the highest type of specialty salesmanship that you can buy. Pick out full-grown men of the age of thirty and upward and pass up the young fellows.

Second—Advertise in the newspapers, on street cars, on the billboards, through the mail and in any other way that will get attention to your wiring campaign.

Third—Make up your mind that the house-wiring business is going to be a permanent feature with you until you have cleaned up all available contracts and leave the question as to whether or not the business is desirable or undesirable to some one with plenty of time to sit down and figure it out.

Fourth—Give your men a new argument every now and then in the form of a special inducement to close, such as a free premium for a limited time. Anything that you can buy cheaply will do, ranging from an 85-cent portable lamp to free energy for two months. The best premium is an electric flatiron.

Fifth—Forget all the electrical contractors in town except one real live one and hitch up with this one in real earnest. Give him the best that you have, work with him, appreciate his difficulties, and don't worry what the others may think of you and your company.

Sixth—Give your wiring efforts a name. We called ours the "Edison home-wiring plan" simply because the word Edison has a peculiar attraction to a lot of people.

Seventh—Bear down hard on the easy terms and forget to worry about the "price per outlet."

Eighth—Get your credit department to see the campaign in the right light. Persuade the credit man that the deposit requirement may be all right in the ordinary run of business, but that the use of that kind of language is entirely too rough when carrying on diplomatic negotiations with a house-wiring "prospect."

Ninth—Don't start off by thinking that you are going to stop in a month or two months or six months and thus give your salesmen the idea that they are merely temporary employees just hanging around waiting for something to turn up.

Tenth—Decide what you are going to spend per contract before you start and then try to save some money—it puts interest into the work. Our men watch our so-called surplus fund as closely as they do their own income.

Eleventh—Don't become alarmed when a wiring salesman starts making more money than the general superintendent. He's worth more, maybe, especially in this particular business.

The essentials of a really successful house-wiring campaign have always been just about as follows:

First—A concise, neatly printed application for wiring, detailing specifications and prices and illustrating a neat lot of sample fixtures good enough for the average home; that is, a predetermined schedule of prices all fixed up in an attractive application ready for the prospective customer to sign.

Second — A super-easy payment plan, preferably one allowing the consumer to pay for the wiring in monthly installments of not more than $5 each. A definite payment per month regardless of the amount of the wiring contract is much better than a monthly payment based on the amount of the contract spread over a number of months. The definite monthly payment is susceptible of more effective advertising than the ordinary installment plan.

Third — An ultra-liberal credit policy. A stingy credit department can wreck a good house-wiring campaign in less time than it takes the proverbial snowball in the lower regions to disappear.

Fourth—Some well-coached, quick-witted, clean-cut, backbone-carrying salesmen, none of whom have ever heard of the profession of electrical engineering and all of whose past experience in sales engineering has been strictly limited to the business of getting prospective customers to take advantage of the opportunity to use the fountain pen on the dotted line—that is, fellows whose long acquaintance with doorbells has made them eager ringers.

Fifth—Honest electrical work installed as promptly as present-day abnormal conditions will permit.

With these essentials firmly incorporated into a house-wiring campaign, such details as price per outlet, newspaper advertising, card-index follow-up, "ginger" talks and "get-together" schemes can be made to pay dividends. Otherwise they cannot.

Economist Urges that Utilities Be Allowed to Earn 9 or 10 per Cent

RATES that will enable public utilities to earn 9 or 10 per cent on their capital are urged by Dr. David Friday, professor of political economy at the University of Michigan, in his new book, "Profits, Wages and Prices." Such rates, he asserts, are essential if utilities are to make a showing that will attract the additional funds necessary to meet the requirements of the public. He points out that while wholesale prices were rising from 100 per cent in 1913 to an average of 212 per cent in 1919, the rates paid railroads and public utilities increased not more than 30 per cent.

"When we consider," comments Dr. Friday, who gained practical utility experience during the war as statistical adviser to the United States Telephone and Telegraph Administration, "that these companies have never earned a rate on their investment which compared favorably with even so conservative a business as banking, it becomes clear that before we can hope for any adequate facilities in these lines we must have a drastic revision of rates."

Referring to the increased value of utility service to businesses which made enormous profits in recent years, the economist says: "There is no reason why those who utilize these services for the purpose of making such profits should not pay a rate for them which yields an adequate return on the investment employed. The prices they receive for their products have doubled, and they can justly be asked to pay double the utility rates, if that be necessary to give an adequate return upon public utility investments."

Readers' Views and Comments

This is a readers' forum. Comments on questions before the electrical industry presenting economic, financial, engineering or commercial aspects and new or supplementary viewpoints on published articles are cordially invited

Economic Value of Interconnecting Isolated and Central Stations Questionable

To the Editor of the ELECTRICAL WORLD:

SIR: In the Jan. 1 issue of the ELECTRICAL WORLD there appeared an article discussing the advantages of "Co-operation for the Central Station and Isolated Plant" in which is advocated the idea of electrical interconnection between the central station and small plants whose purpose is primarily the production of steam heat. There are, no doubt, many cases where the production of electrical energy as a by-product of steam heat and the sale of the surplus of such energy to the central station might result in advantage to both parties. As a general proposition, however, it is believed that the economy of such a practice is not self-evident. The idea should be approached with caution and all influencing elements carefully considered.

From the point of view of the small plant it is simply a question of whether the electrical energy needed at that plant can be produced locally at a cheaper cost than the price charged by the central station for supplying the same energy. The cost must include annual charges on the generating equipment and additional apparatus necessary to utilize the steam, also the additional cost of coal (to produce the extra pressure) and other operating expenses if any. In case the cost is greater than the central-station rate, the further consideration is necessary of whether additional surplus energy can be produced and sold to the central station at a profit which will make the whole installation economical. The deciding factor in such a case is the price which the central station can afford to pay for such energy.

On the other hand, from the central station's point of view, the question is whether the energy which can be bought from the private plant can be resold, and if so whether the cost will be less than the cost of the same energy produced at the central plant and transmitted to that point. If such energy may be obtained at time of peak load and is dependable, the advantage may be considerable. If, however, there is no demand for such energy at nearby points at the time it is available, or if the supply is more or less intermittent, it may be worth very little. If the central station must maintain generating capacity, transmission and distribution line capacity, etc., to supply the full amount of such load at certain times of the day or year when the local supply is not available, the demand cost will not be reduced and only the kilowatt-hour cost will be saved on the energy purchased. Since this may be less than one-half the total cost of such energy, it may well be conceived that, with a less efficient plant, the smaller station could not afford to sell such energy at less than this cost.

If, in addition to this, the central station is called upon to supply the energy requirements of the local

plant at such times as the heating plant is not required, the demand cost on such energy must be charged, which would make the cost per kilowatt-hour used considerably more than it would be for full-time consumption. This would reduce the apparent economy of the small power installation.

All these points should be carefully considered when such an installation is contemplated. That scheme which will give the best over-all economy for both parties combined will be most advantageous for each.

Detroit Edison Company, HOWARD P. SEELYE,
Detroit, Mich. Distribution Engineering Dept.

Cause of Fires Not Accurately Reported

To the Editor of the ELECTRICAL WORLD:

SIR: Supplementing "A Reader's" statement in your issue of Feb. 19—that causes of fires are not accurately reported—I would add that this has been my experience also. For several years I was employed by a public utility corporation. Part of my work was to inspect and reinstall metering and service equipment. Previous to the inspection and as soon after a fire as possible a report of the cause was made by a police officer, and in probably 50 per cent of the reports this was necessarily guesswork. In many fires of doubtful origin the electric wiring was reported as the cause, although frequently an electric conduit or distributing system was still in operation.

It is surprising how an unqualified person reporting causes of fires may be influenced by the defective-wiring theory. Here is an instance: A fire occurred in the woodbin of the cellar of a tenement house. Strung from the floor joists and stapled to the under side were the bell wires, about 5 or 6 in. apart. These were of the usual No. 16 annunciator wire, and connected to them were two dry cells. At no point did they come near lighting wires, yet a fire that started in the bin owing to a tenant dropping a lighted match was attributed to defective wiring because the joists had been charred by the flames, and this regardless of the fact that even these wires at the time of inspection were not and could not be in contact.

In another case coming under the writer's observation, in a new dwelling, a plumber accidentally cut through a gas pipe with a hacksaw. The accumulated gas from the leak finally caused an explosion, but the reported cause was defective electric wiring, although the wires were not yet connected to the service mains!

MATHEW KING,
Electrical Engineer.

The Standard Textile Products Company,
Passaic, N. J.

Effect of Ground Wires on Inductive Interference

To the Editor of the ELECTRICAL WORLD:

SIR: On page 544 of the ELECTRICAL WORLD for March 5, 1921, the writer has noticed an article entitled "Telephone Noises Reduced by Double Overhead Ground Wire." The California Joint Committee on Inductive Interference made a study of the effect of ground wires on the inductive interference from a power circuit in a case very closely resembling the one described in this article, with this difference, that the telephone line considered was placed at horizontal separations of 65 ft. and 1,040 ft. instead of being immediately beneath the power circuit. The results of the study were published in "Inductive Interference," issued by the California Railroad Commission in 1919, on page 1088 f.f.

The results of that study indicated that the most striking effect of the ground wires is to reduce greatly the inequalities among the capacitances of the line wires to ground, thus reducing the unbalanced voltage to ground (the residual voltage) to about one-third of its value without ground wires. The shielding effect of the ground wires for both electric and magnetic induction was shown. It was found that the effect of the ground wires upon the magnetic induction arising from the balanced currents would be either to increase or to decrease the induction, depending upon the direction of phase rotation of the balanced currents. The complete discussion may be found in the publication to which reference has just been made. D. I. CONE.

Pacific Telephone & Telegraph Company,
San Francisco, Cal.

Actual Versus Reproduction Cost in Public Utility Appraisals

To the Editor of the ELECTRICAL WORLD:

SIR: Referring to the letter from the undersigned which was published in your issue of Jan. 29, the attached table may be of interest as additional information. This table shows the book value of the property referred to and the additions and depreciation reserve illustrating how it can be carried along from year to year.

The table which was presented with my letter already referred to showed only the amount deducted for depreciation. This information, together with that already published, shows not simply depreciation but the balance of the property as carried upon the books after depreciation had been deducted.

C. W. KOINER,
Municipal Lighting Department, General Manager.
Pasadena, Cal.

SCHEDULE OF PROPERTY AND DEPRECIATION

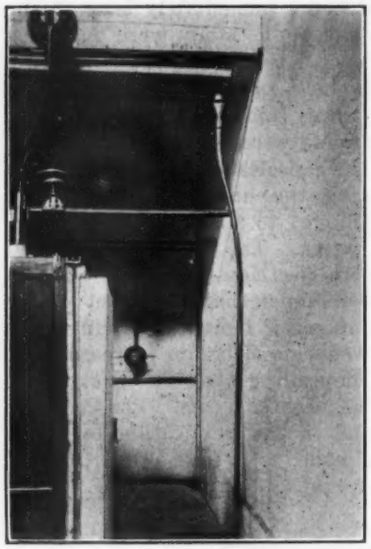
	Book Value			Depreciation Reserve			Replacements from Depreciation Reserve	Present Depreciated Value
	Balance July 1, 1919	Additions During Year	Total July 1, 1920	Total July 1, 1919	Additions During Year	Total July 1, 1920		June 30, 1920
Real estate and buildings	$32,792.36	$2,138.26	$34,930.62	$7,805.88	$997.39	$8,803.27	.....	$26,127.35
Station equipment, boilers, generators, etc.	307,257.60	32,731.32	339,988.92	101,147.65	18,749.09	119,996.74	.....	220,097.57
Overhead lines for commercial service, including electric services, poles, cross-arms, wires, etc.	265,199.12	29,618.06	294,817.18	65,588.41	11,126.65	76,715.06	$980.92	219,077.65
Underground lines for commercial service conduits, cables, wires, etc.	17,610.26	5,925.33	23,535.59	1,593.07	424.98	2,018.05	.....	21,517.54
Transformers and devices	69,969.01	5,946.59	75,915.60	17,362.76	3,109.45	20,472.21	472.32	55,915.71
Meters	109,636.48	10,466.56	120,103.04	32,994.98	4,632.03	37,627.01	584.17	83,060.20
Municipal street-lighting system	162,209.51	2,194.47	164,403.98	79,382.05	7,494.27	86,876.32	966.03	78,493.69
General equipment	28,340.19	3,360.08	31,700.27	18,091.17	3,811.19	21,902.36	1,962.85	11,760.76
Telephone lines	65.32	.....	65.32	12.20	3.27	15.47	.....	49.85
Total	*$993,079.85	$92,380.67	$1,085,460.52	$323,978.17	$50,348.32	$374,326.49	$4,966.29	$716,100.32

* Does not include inventory, cash or government bonds.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Protecting Oil Switches from Dampness



IRON DRIP PAN CATCHES CONDENSATION FROM OVERHEAD BEAM

TROUBLE due to condensation of moisture above a 33,000-volt oil-switch compartment was eliminated by installing a galvanized-iron drip pan beneath the reinforced-concrete beams forming the interior framing on the hollow dam at the Ellsworth (Me.) hydro-electric plant of the Bar Harbor & Union River Power Company. A funnel and a 1-in. pipe are provided to drain the trough, as illustrated in the accompanying half-tone. The trough has proved very satisfactory for its purpose. A. P. Royal is chief engineer of the Ellsworth plant.

Boston, Mass. FIELD EDITOR ELECTRICAL WORLD.

Good Fireman as Necessary as Boiler Instruments

IT MAY be said that the most important man in a power plant is the fireman. He handles large quantities of an expensive raw material and has a splendid opportunity to waste as much as he likes. The boiler may be equipped with all kinds of instruments, but they represent money thrown away unless the fireman can understand them. Given a high-class fireman, then the more instruments he has the better. These should consist of a flow meter and draft gages for indicating the draft at several points. It is impossible to work any of the modern types of forced-draft stokers without them. All instruments should be indicating as they are for the use of the fireman and not to fill a filing cabinet.

Control stations for fan speeds or stoker motors should be so placed that the firemen can make the necessary adjustments while he is looking at the instruments. CO_2 machines are useful, but do not tell the whole story, as a man can easily get a high CO_2 and still be wasting coal.

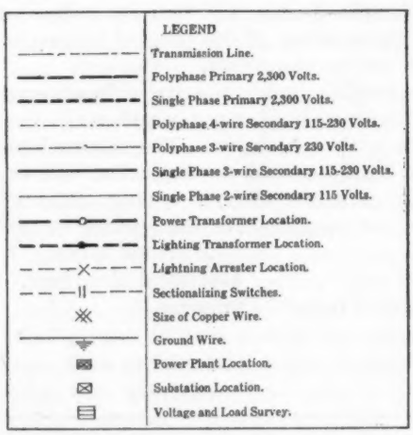
A useful instrument is a flow meter of the indicating type so that the fireman can see which boilers are carrying the load and whether he is working too many boilers or too few. Of course, there are many instruments that are useful, such as thermometers showing the temperature of the gases leaving the boiler or economizer, but a good fireman can get all there is out of a boiler by means of draft gages and flow meters and by observing the fire.

Every boiler should be checked up regularly by test instruments to locate and correct defects. The important thing to look for is air leakage in the boiler setting. It is not unusual to raise the efficiency of a boiler 5 per cent by reducing the air leakage even in plants which were considered to be run economically. To get good results there are two main points to observe —train the fireman and keep boilers in good condition.

Sargent & Lundy, Chicago, Ill. A. B. CLARK, Engineer.

Map of Distribution System Should Be Easy to Revise

A MAP showing a company's distribution system should have two prime advantages—(1) the legend used should be such as to be very easily understood by the average workman; (2) the legend should be so arranged that on the progressive stages of line construction it will be necessary to erase only a minimum number of the present lines to illustrate the changes. That is, on changing a single-phase primary circuit to a polyphase circuit, or changing a two-wire to a three-wire secondary, it should be necessary only to rule a heavier line over the present circuit. Such a legend is shown in the accompanying drawings. By indicating transformers, lightning arresters and switches on the reverse side of the tracing these can be changed without marring the present layout.



LEGEND FOR MAP OF DISTRIBUTION SYSTEM

A copy of the map embodying the different circuits should be in the hands of every man having to work on or refer to any part of the distribution system. Some method should be followed to keep the map up to date after a survey of the distribution system has been made. Corrections can be made in the original tracing from the regular work orders. The map should be on a scale which will not crowd the circuits excessively. The circuits should be easily distinguishable to the average workman. In larger cities it may be an excellent plan to have sectional maps,

while in towns of 30,000 to 40,000 one map on a scale of 500 ft. to 1 in. would probably be more adaptable. The scale to be used depends on the density of distribution circuits.

THEODORE H. RICE,
Operating Department.
Henry L. Doherty & Co.,
New York, N. Y.

Barrel Rheostat Handles 1,600 Amp. at 125 Volts

A VERY convenient form of water-cooled resistor for loading exciters on test, built for one of the Eastern power companies, is shown in the accompanying illustration. It is large enough to load a 200-kw., 125-volt exciter to full load from a minimum load of 10 kw. at 125 volts and increasing in steps of 10 kw. The resistor is so constructed that it will fit into a standard-size lubricating-oil barrel and is cooled by running fresh water into the barrel through a rubber hose and either allowing it to run over the top or drawing it off with another hose. The resistor costs about $150 and weighs approximately 150 lb. exclusive of the barrel.

BILL OF MATERIAL FOR RHEOSTAT WHICH HANDLES 200 KW. AT 125 VOLTS

Twenty resistance units, General Electric Company, size Z, form R, symbol 1.9Z.
Three switches, S.P.S.T., back connection, 200 amp.
Five switches, S.P.S.T., back connection, 60 amp.
43 lb. of strap iron, ¼ in. x 1¼ in., cut into eight 33½-in. pieces, sixteen 6½-in. pieces, two 16-in. pieces, two 12-in. pieces, four 4-in. pieces.
Eight machine bolts, ½ in. x 9½ in., with nuts.
Ten machine bolts, ¼ in. x 1½ in., with nuts.
Twenty-eight machine bolts, ¼ in. x ⅞ in., with nuts.
Eight machine bolts, ¼ in. x 1¼ in., with nuts.
Forty brass machine bolts, ⅛ in. x ⅜ in., with nuts.
18 in. of copper, ⅛ in. x 2 in.
4 ft. of copper, ⅛ in. x ¼ in.
5 ft. of copper, ¼ in. x 1¼ in.
18 in. of fiber, ¼ in. x 1 in.
45 ft. of copper wire, No. 6 B. & S., rubber-covered.
15 lb. of ½-in. round iron washers.
One slate or fiber top, 12 in. x 18 in.
Tape, red lead and insulating paint and one standard-size oil barrel.

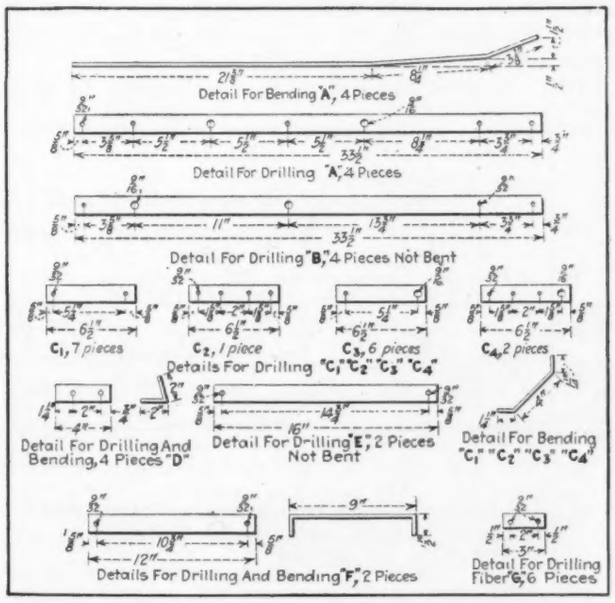

Detail For Bending "A", 4 Pieces
Detail For Drilling "A", 4 Pieces
Detail For Drilling "B", 4 Pieces Not Bent
C1, 7 pieces
C2, 1 piece
C3, 6 pieces
C4, 2 pieces
Details For Drilling "C1" "C2" "C3" "C4"
Detail For Drilling And Bending, 4 Pieces "D"
Detail For Drilling "E", 2 Pieces Not Bent
Detail For Bending "C1" "C2" "C3" "C4"
Details For Drilling And Bending "F", 2 Pieces
Detail For Drilling Fiber "G", 6 Pieces

FIG. 1—DETAILS OF PARTS USED IN WATER-COOLED RHEOSTAT

The strap-iron pieces for the frame are cut, drilled and bent as shown in Fig. 1. The resistor is then assembled, using the washers on the long bolts as separators for the resistor units. The end units are placed directly alongside of the upright cornerpieces and the intermediate units are equally spaced. Copper strap, ¼ in. x 1¼ in., forms the common lead for each set of resistors. This is supported at one corner of the frame by six fiber pieces *G*.

The switches are placed on the slate or fiber top so that the hinged parts come in a straight line. A 14-in. x 2-in. piece of copper forms the common terminal and has several free inches on the end for connection to a cable. After the switches are mounted on the top the common terminal is wired with No. 6 rubber-covered wire as shown in the diagram, ⅛-in. by ½-in. copper being used as the common connection on each row of units. The wires are taped together and painted with insulating paint. The ends of all the bolts are cut off and filed smooth, and to all the metal parts a coat of red lead and insulating paint is given. To prevent fusing of the switches a circuit breaker should be inserted in the circuit between the machine under test and the loading resistance.

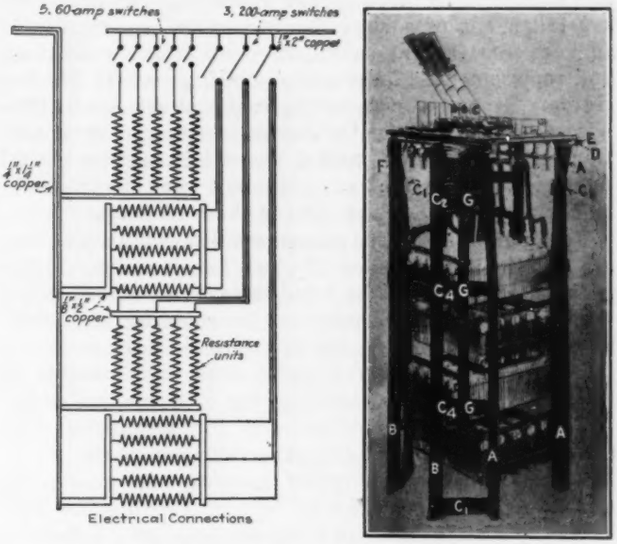


FIG. 2—WATER-COOLED RHEOSTAT TO BE MOUNTED IN OIL BARREL WILL HANDLE 200 KW. AT 125 VOLTS

FRANK H. BROOME.
Jersey City, N. J.

Maintenance Schedule for 35,000-Kva. Generating Plant

INSPECTIONS necessary to keep a plant in efficient operating condition may be divided into two classes—(1) periodic examination which does not require taking equipment out of service, and (2) thorough and less frequent inspection involving more or less dismantling of equipment. In the following paragraphs a schedule followed by the maintenance organization in a 35,000-kva. plant is given. (See ELECTRICAL WORLD, March 26, page 713, for a description of the organization.)

A continuous check on the boiler-plant efficiency should be possible by means of fuel and steam tests and from the records of permanent measuring devices. These will serve as a guide on both operation and maintenance of the boilers. In these inspections during operation lies the field for co-operation between the two departments which will result in suspected troubles being reported to the supervisor of maintenance. Flue-gas temperature should be noted at least weekly, and at the same time baffles should be inspected for leaks. Note should also be taken of the conditions of the ex-

ternal heating surface, in so far as this is possible during operation, to obviate undue accumulations of ash, slag or soot. Similar frequent inspection of furnace brickwork will permit repairs being made before the deterioration has become too serious. Safety valves should be tested at least biweekly. Once in three months, or oftener if operating conditions require, boilers should be opened and inspection made of external and internal surfaces. At this time the condition of soot-blower elements can be carefully noted.

Stoker defects are usually noticed during operation and should be reported by the operators. When boilers are taken out of service for inspection opportunity is afforded for careful examination of stoker conditions and replacements of any parts showing serious deterioration. Systems for handling coal and ashes will likewise frequently reveal their weak points during operation. In addition, a careful general inspection should be made monthly, and any seriously worn parts should be replaced without waiting for them to break.

Feed pumps should be opened and inspected once every six months, and oftener if conditions require. Overspeed devices should be tried once a week. Cleaning of feed-water heaters may not be required frequently unless water conditions are bad, but the heaters should be inspected internally at least every six months, or whenever opened for cleaning, for evidences of corrosion or other deterioration and for difficulties with float-valve mechanisms and other movable parts.

The inspections of prime movers and auxiliaries should include a continuous test of turbines by permanently installed meters to detect decrease in efficiency and weekly inspection to determine the position of rotor following any wear or displacement of thrust-bearing parts. It is good practice to check the overspeed devices by employing them instead of the throttle to shut the machine down. The automatic stop valve is the most important safety device on the turbine, and by this practice its maintenance in operating condition is assured.

Opening and careful inspection of turbines and generators is necessary once a year to determine wear of important parts, such as nozzles, blading and bearings, and to find any fouling conditions of turbines or generators.

Semi-annual or annual overvoltage tests of turbogenerator armature windings, preferably using some form of variable-ratio potential transformer of ample size, are desirable. The magnitude of overvoltage should depend upon the character and general condition of insulation, the age of the machine and other conditions. In general the over-voltage should range from 125 to 200 per cent.

Test should be made for condenser-water leakage by chemical or electrical (resistance) means at least weekly, and daily if circulating water is bad. Monthly tests by means of an air bell will detect condenser-air leakage. Thorough inspections of internal condenser surfaces are justified monthly, unless required oftener by operating conditions. Inspection should be made semi-annually of circulating-pump runners and other internal wearing parts and of wearing parts of air and condensate pumps as well as driving turbines, if any, with tests of overspeed devices.

Plant motors should be observed daily and should also have a careful inspection monthly, particular attention being given to cleanliness, proper cooling of bearings, clearance between rotor and stator, etc. Overload and underload automatic devices should also be tested monthly.

The switchboard should be looked over frequently, and semi-annually there should be a careful inspection, including a test of meters. Special attention should be given to cleanliness.

Oil switches require occasional inspection, and semi-annually they should be opened up for replacement of oil, removal of dirt or carbonization and to make sure that the mechanism is working properly. Every three months all relays should be tested.

Rotaries and motor-generator sets require frequent observation and careful semi-annual inspection, with special attention to cleanliness, proper cooling of bearings, adjustment of brushes, smoothness of commutator and other important details.

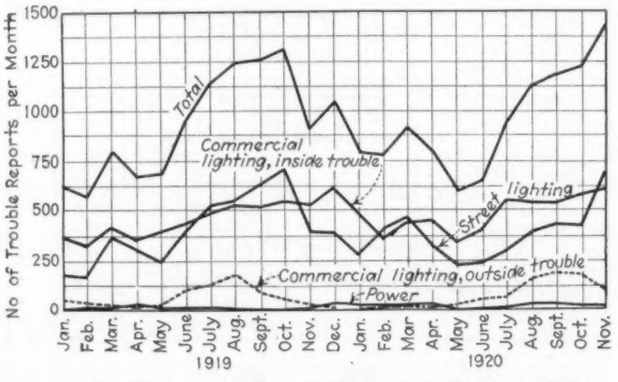
S. B. FLAGG,
Electric Bond & Share Company, Engineer.
New York City.

Graphic Reports Aid Company in Removing Causes of Trouble

GRAPHIC reports have proved very valuable to the management of the Worcester (Mass.) Electric Light Company in making scientific analyses of its distribution department problems. One report of this kind is shown herewith which gives the number of troubles in different classes of service from month to month. These curves are kept up to date from the monthly records.

A curve which rises abnormally fast indicates that troubles in this type of service are becoming too frequent and that the causes of the troubles should be discovered and removed in order to forestall further trouble. In this diagram are shown the number of troubles reported per month in four classes of service —commercial lighting, inside trouble; commercial lighting, outside trouble; street lighting, and service to power customers. A fifth curve shows the total number of troubles on all these classes of service.

This company finds it very advantageous to show



GRAPHIC REPRESENTATION OF REPORTS INDICATES WHEN TROUBLE IS BECOMING FREQUENT ON DISTRIBUTION SERVICE

many conditions of operation by means of graphs. In subsequent issues several other forms will be shown, including those used for meter reading, testing and installation, labor cost, pole setting, arc-lamp information, etc.

GEORGE M. HARDY,
Worcester Electric Light Company, Superintendent.
Worcester, Mass.

Industrial Applications

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Job Order Records Check Costs

TO KEEP a continuous check on the installation and operating costs of the electrical equipment of the Southwestern Shipbuilding Company, East San Pedro, Cal., the electrical department has for some time made use of the cards shown in the illustration. These are standard 4-in. x 6-in. cards. Every job order is

J. O. No. 642 — ELECTRICAL DEPARTMENT — Period No. —
JOB ORDER RECORD

DATE	EMP. NO.	HRS.	AMOUNT	DATE	EMP. NO.	HRS.	AMOUNT	DATE	EMP. NO.	HRS.	AMOUNT
3-16-21	100	8	8 00	FWD			72 00	FWD.			
"	1010	8	5 60	3-19-21	100	2½	2 50				
"	1032	8	5 60	"	1010	5	3 50				
"	1925	8	4 80	"	1925	5	3 00				
"	1122	8	4 80								
3-17-21	100	8	8 00								
"	1010	8	5 60								
"	1032	8	5 60								
"	1925	8	4 80								
"	1122	8	4 80								
3-18-21	100	4	4 00					FWD.			
"	1010	8	5 60					PERIOD TOTAL			80 00
"	1925	8	4 80					PREV. TOTAL			
FWD.			72 00	FWD.			80 00	JOB TOTAL			80 00

COST OF A JOB IS KEPT UP TO DATE BY DAILY ENTRIES ON THIS CARD

entered on a separate card, and every day on which work chargeable to a particular job is done, the date, the employee's number, the hours worked and the total amount charged are entered. This permits the electrical engineer to watch the costs on each job carefully and keep them within the appropriation.

A. G. HUMPHREY,
Electrical Engineer.
Southwestern Shipbuilding Company,
East San Pedro, Cal.

Refilling Inclosed Fuses

TO REFILL inclosed fuses is a practice generally condemned because the wrong size of fuse wire can be used in a fuse marked for a certain current. However, this method of reclaiming fuses is sometimes practiced, and in such cases safety should be insured by careful and proper refilling. In the first place, all fuses should be sorted for size and then tested with a lamp for good or bad circuit. In handling be sure that each size is kept by itself. For the smaller sizes with cylindrical contact surfaces bore a $\frac{1}{16}$-in. hole through one ventilation hole at each end of the fuse tube and run a stiff iron wire all the way through to open a path for the fuse wire. Next, insert a piece of fuse wire of the proper amperage, leaving $\frac{1}{2}$ in. outside each end, which is bent over flat. After cleaning the end of each ferrule and the fuse wire, solder the latter down securely. Care must be taken not to melt the wire except at its ends and thus open the circuit. Too much solder should not be used as the fuse would be made too long to fit the cut-out block. These operations apply to all sizes up to and including 60-amp. fuses. Above this size fuses are of the knife-blade type, which must be disassembled and fused more carefully for exact length.

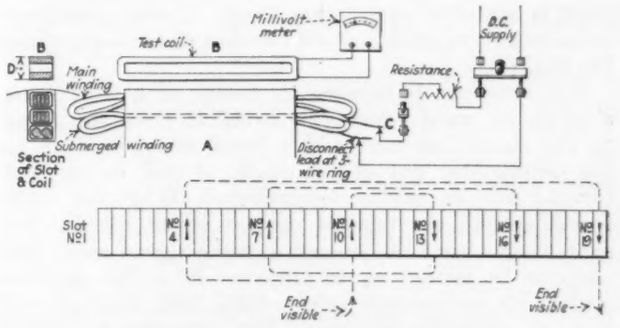
The first one or two fuses of each size should be tested with an ammeter and a rheostat consisting of a wooden pail of water containing a little salt or soda. If the fuse carries more than its proper rating, the wire should thereafter be filed down thin for part of its length and again tested.

After refilling and testing, the ferrule should be polished clean of all solder and dirt, so as to make perfect contact in the cut-outs. If any of the labels and other size markings are missing, write on the size plainly with pen and ink.

H. S. RICH.
East Berlin, Conn.

Kick Method of Locating Submerged Conductors in Armatures

A NUMBER of cases have come to the writer's attention where it has been desirable to locate the direction of winding and the position of turns in a submerged winding, such, for instance, as a reversed coil or turn in a Burke three-wire generator, where the balancing windings are placed under the main winding. To do this a current is passed through one of the submerged windings in the armature (*A* in the accompanying sketch) and a long narrow coil *B* is placed lengthwise along the armature and directly above the slot



HOW POSITION AND DIRECTION OF SUBMERGED WINDING IS DETERMINED

which it is desired to explore. The current in the three-wire winding is broken by means of the switch *C*, and a kick is observed on the millivolt meter *M*. The magnitude of the kick in the meter will indicate whether the slot under the coil *B* contains two active conductors or one active conductor, and its direction will tell the direction in which the current is flowing. The dimension *D* of the coil *B* should be small, as this coil will

measure not only the leakage flux from the slot under observation but also the leakage flux from the complete armature. If the dimension *D* is small, the value of the leakage flux crossing the slot which is being investigated through the coil *B* is so much greater than the leakage through the coil *B* from the total armature that the armature leakage has no large effect on the meter. Of course, the coil *B* must be close to the slot and, if possible, should just enter the top of the slot. All slots in the armature are investigated, and when this is done a developed diagram of the armature is laid out, as shown at the bottom of the drawing, indicating the direction of the current (meter kick) by arrows. The start and finish of the winding can generally be seen, and it is then possible to connect together on the diagram the ends of the slots by dotted lines, and as the entire submerged winding is symmetrical, it can be at once laid out without having to turn to a drawing. If a drawing is available, the layout of the winding can then be checked against the drawing.

Coil *B* may be wound on a ½-in. board 2 in. x 12 in. in size. A ¼-in. notch ⅜ in. deep is made in each end of the board and the notches are wound full of No. 28 magnet wire. The notches are cut along the end of the board so that the coil measures inside 2 in. x 12 in. A screw eye or nail is put near each end of the board and a strand of a lamp cord is tied to each screw eye. The leads of the coil are then soldered to the lamp cord.

Newark, N. J. F. W. Gay.

End Welded on Motor Shaft Without Removing Winding

Instead of replacing a badly damaged armature shaft, one large industrial establishment welds a new end to the shaft without removing the winding. Although it may take four men to make the best weld, it is much cheaper than to remove the windings and press the commutator and core off the old shaft and onto a new one, A saving of something like $50 per shaft may be realized by the method. It has been used for more than three years, and as many as four or five have been thus repaired in a day. In this method the shaft is heated in an ordinary forge. It may sometimes be necessary to place a shield between the armature and the fire.

The armature is handled by means of a sling from a small jib crane which can swing it from the forge to the steam hammer, and a hand wheel is fixed to the commutator end of the shaft so that the desired turning may be readily accomplished. When the shaft is hot enough the tapered portion is cut off and the shaft is split back far enough to make a good weld. The piece to be welded on is prepared in a like manner. Both parts are brought to a welding heat and the weld is made under the hammer. The armature is rotated and the shaft is shaped and drawn out ready for turning in a lathe.

Of course, if the shaft is only slightly damaged it is easily repaired. It sometimes happens that the keyway in an armature shaft becomes enlarged or tears out so that the pinion becomes loosened. If the shaft is not badly damaged, the keyway may be filled up with a metallic-arc weld and a new keyway cut in another location. But if the second keyway tears out, or if the tapered portion of the shaft becomes so badly damaged that a new one seems to be required, then it will pay to consider another method of repairing the shaft instead of replacing it by a new one.

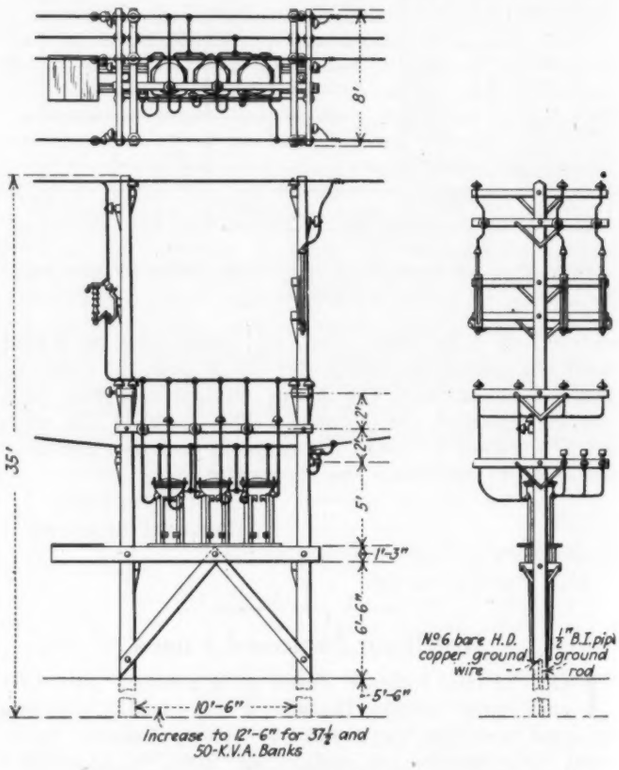
In this plant it is also customary to straighten bent shafts without removing the windings or commutator. If there is not much of a twist in a shaft it may be straightened in an ordinary shaft straightener such as may be found in the machine shop of most large industrial works.

The saving which is obtained by straightening a shaft with the armature assembled complete is, of course, even greater than that in the welding repair described. D. W. Blakeslee.

Pittsburgh, Pa.

Standard 11-Kv. Substations for Kansas Oil Fields

The standard 11,000/440-volt substation used in the Eldorado oil fields to provide electric service for pumping oil is shown in the accompanying illustration. The distribution is 11,000-volt, three-phase, and the transformer banks are connected in Y, allowing the use of standard 6,600-volt transformers. The neutral point of the transformer Y is grounded for each bank. A



SUBSTATION RATED AT 11,000/440 VOLTS FOR OIL-FIELD DISTRIBUTION

No. 6 hard-drawn bare copper wire connected to a ½-in. driven pipe is used for grounding. The fuses protecting the primary side of the transformers are 25-amp. (General Electric T.D. 227). They are for protection against short circuit and not for overload. The 440-volt sides of the transformers are connected in delta. Lightning arresters for both high and low sides are installed on crossarms mounted on the poles.

Empire Gas & Fuel Company, S. B. Severson,
Eldorado, Kan. Assistant Chief Engineer.

Routing Storage Batteries Through a Repair Shop

WITH the widespread use of storage batteries for automobile lighting and starting and for electric haulage by means of mine locomotives and industrial trucks and tractors the problem of handling battery repairs has become an important part of the work carried on in repair shops. In some cases it has been necessary to put this work on a production basis, while in others it may be handled in a more simple manner as a side line to motor winding and for other classes of work.

The battery repair work of the Electric Motor & Repair Company, Newark, N. J., on account of the number of automobile starting and lighting batteries received, has been placed virtually on a production basis, and it is thought that some of the methods of handling repairs will be of interest to repair shops.

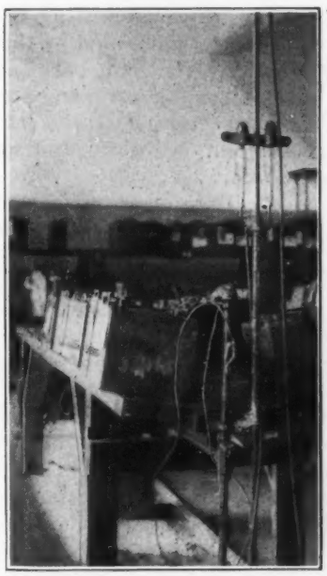
Batteries are received at a central point on the first floor of the shop, where they are submitted to an examining test in which the following points are noted: Specific gravity, voltage on open circuit and at highest discharge rate, test applied for location of any low or dead cells, loose connections, and the general condition of the box, sealing, handles and terminals, and identifying marks are carefully noted. In commercial work the identifying marks such as make, voltage, capacity, battery number and type, whether special or standard, are very important for record and tracing purposes.

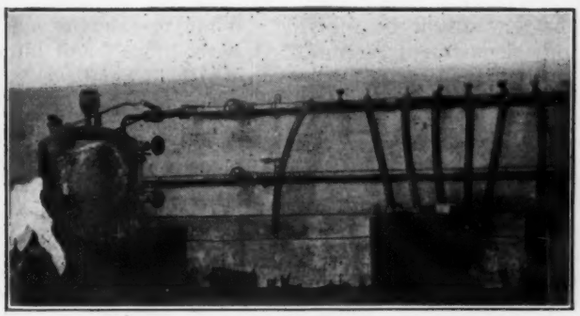
At the time the battery is received the accompanying card form is filled out. In the case of commercial work this is possibly more important than would be the case in an industrial repair shop. It is also important in this case to determine as near as possible what work is to be done, whether it is simply a recharge or repair or whether new parts for the battery are required. These points can almost always be determined by the tests which are applied on receipt of the battery.

A work order is then made out, and the battery is taken to the battery room on drop platform trucks. The batteries are segregated as to the type of work to be done, those requiring only recharging being taken to the charging benches, while all those requiring opening are left at the steaming table.

The batteries are placed in a definite order in respect to capacity and voltage on the charging table shown in the accompanying illustration. Those batteries that have nearly the same capacity are placed together and connected in series, or according to the charging system used.

Battery benches are an important part of the repair shop equipment, and they should be carefully designed for the work and properly maintained. The benches shown are designed so that the tops slope toward the center and any acid or water is carried into an insulated lead trough sloping from both ends of the bench toward the center, where a lead drainpipe carries the acid or water to an earthenware or rubber jar. Benches should be painted weekly in order to preserve them from the effects of acids. Each bench is equipped with hydrometer rack and a conduit outlet for the charging leads. Pure water for filling the batteries is piped throughout the shop and is taken from a float tank maintaining a constant level. At each charging bench there is a water outlet to which a ½-in. rubber hose, long enough to reach to any part of the bench, is attached.





BATTERY REPAIRS ARE FACILITATED BY PROPERLY EQUIPPING A SHOP FOR THE WORK

On the left is shown a charging bench equipped with a rubber-hose water connection for filling the batteries, hydrometers conveniently located and flexible leads with clips to attach the battery to the line. Several batteries may be placed on the steaming table (center view) and left until the compound has softened sufficiently to permit withdrawing the covers with the groups. The connections to the steam line are lengths of hose. Terminals and connectors are burned on with an oxyacetylene torch.

The leads for connecting up the batteries for charge should be flexible-conductor, rubber-covered wire, and not smaller than No. 10 gage. The type of snap clips which are used for making the connection is very important, especially when the charging is done at night without supervision. Several types of clips, which are made of two pieces and use a spring to hold the contact on the battery terminal, have given trouble due to corrosion insulating the two halves from each other, causing the charging current to flow through the spring. The consequent heating of the spring takes out the temper and results in the clip becoming loose and falling off. This breaking of the charging circuit and consequent arcing may result in local cell explosions or, in the case of lines charged through a mercury-arc rectifier, means an increased current in the other lines, or the shutting down of the rectifier because of "fluttering" of the arc at the time of the interruption. One-piece clips have eliminated trouble of this kind.

The first operation in repairing a battery is to drill off the cell connectors and terminals. This is done by drilling through the terminal or strap connecter down

to a level with the terminal post, which frees the connector. These straps and terminals, if not in bad condition, are used again.

When a dead cell is found, or for any reason a battery requires opening and inspection or repair, the instrument is delivered to the steaming table, where the cover is steamed off. When steam is accessible from the heating system the work is done by using this source of heating. In the summer months, however, when no steam is available from this source, a small boiler is used, which gives a pressure of 5 lb. for the work. As shown in the illustration, the steam is taken from the main steam line through lengths of rubber hose which are inserted in the opening of each cell. In five or ten minutes the compound is sufficiently soft and the covers with the groups may be drawn out with a pair of pliers. After the cells are opened the remaining acid is emptied out and the cells are sprayed with water, the cell being in an inverted position. The force of the water is generally sufficient to remove any sediment.

After this spraying the plates are set, tipped into the jars for draining and then taken to the repair bench, where new separators or plates are fitted according to the nature of the work to be done. The cells are then reassembled, straps and terminals being burned on with an oxyacetylene torch. Sealing and compound flowing is then done and the battery box receives a coat of black acid-resisting paint.

One of the important points in routing a battery through the repair shop, particularly in the case of commercial work, is to facilitate the prompt location of a battery when wanted. In the case of this repair shop there are five places where a battery might be found —first, in the opening or steaming department; second, the waiting rack; third, the repair benches; fourth, the charging benches, and fifth, the "ready" rack. Each

REC'D BY _____ DATE _____
CHECK No. 13450 LEAD TAG No. _____
NAME _____
ADDRESS _____
MAKE _____ BAT. No. _____
TYPE _____ VOLTS _____
THEIR ORDER No. _____
MAKE OF CAR _____ LIC. No. _____
RECHARGE _____
RENTAL BAT. No. _____
REPAIR _____
REMARKS _____
TOTAL AMOUNT _____
BAT. DELIVERED TO _____
SIGNED _____
"Exide" SERVICE STATION

REC'D BY _____ DATE _____
CHECK No. 13450 LEAD TAG No. _____
REQUEST TO INSPECT (DATE) _____
REPAIRS _____
REPORT (DATE) _____
NEW BATTERY TYPE _____ PRICE _____
ON TABLE No. _____ ON RACK No. _____

Cost of Repairs		
POS. ELEMENTS		
NEG. ELEMENTS		
SEPS.		
JARS		
RECHARGE		
TOTAL		

FORM USED FOR RECORDING BATTERY REPAIR WORK

job received has a serial number. This serial number corresponds to the one stamped on a paraffine-coated, acid-proof, lead-wired manila tag which is attached to the battery. When the battery reaches the repair shop a small card form is found which bears the same serial number as the original record. On this card are entered the various locations of the battery as it proceeds through the shop. If charging only is required, the number of the charging table is entered on the card, while if it is necessary to repair the battery, the different locations are entered until the battery finally gets to the ready rack. To find a battery all that is necessary is for the office to call the serial number by means of a loud-speaking telephone and the repairman ascertains the location by reference to the card file. Although several hundred batteries may be on hand, it is usually possible to locate the one wanted and deliver it in about forty seconds. Loud-speaking telephones are a valuable adjunct to the repair shop as they permit communication of the office and the receiving and delivery stations with the repair shop without taking the repairmen from their work. It is possible to talk from any part of the shop to the office without unduly raising the voice.

H. C. HEIDRICH,
Electric Motor & Repair Company, President.
Newark, N. J.

Repairing Squirrel-Cage Rotors

OCCASIONALLY poor contacts develop in the squirrel-cage windings of induction-motor rotors. Such trouble usually makes its presence known by the rotor having a very low starting or running torque or a dead point from which it will not start at all. Poor contacts are frequently caused by loose bearings permitting the rotor to rub the stator core. The heat generated by this rubbing overheats the joints between the rotor bars and rings. If these joints are soldered, as a great many are, the solder is thrown out, leaving a high-resistance contact. With the screw type of joint, when the contact becomes poor the surfaces are darkened. Even rotors with the rings cast around the bars once in a great while give trouble by a bar breaking at the point of contact with the ring.

When resoldering a ring, dismantling it for cleaning is both difficult and unnecessary. A very efficient way in which to handle a resoldering job is as follows: Remove as much of the paint and dirt as possible with a scraper and a wire brush. Then apply a strong soldering acid and a hot flame. Use plenty of acid and make sure the parts are well heated so that the solder will run freely. This will remove any excess paint and other substances. Burning the slot insulation can do no harm as it makes no difference whether insulation is present or not. After soldering remove all traces of the soldering acid by washing the rotor thoroughly with a hot solution of caustic soda and then wash again in hot water to remove the soda. The rotor is then placed in an oven and baked until all moisture is driven out, after which it is ready for painting. The paint should be thin so that it will run freely into the spaces in the slots and thus tighten the bars in the core.

In the repair of rotors with laminated end rings welding is often resorted to with success. When welding copper to copper a soft copper wire should be used as a flux, and not a brass wire as is often done.

When a rotor with screw-connected joints is to be repaired it is frequently best to remove all the bars and thoroughly clean them and the rings. Removing the screws is often quite difficult as they are usually burred with a center punch. To overcome this the writer uses an electric drill to cut out the burred portion of the screw and bar. The reassembling is easy, but particular care should be paid to see that all the screws are drawn quite tight.

A. HERVEY.
New York, N. Y.

Detachable Lighting Fixture Reduces Cleaning Expense

THE cost and difficulty of maintaining lighting equipment in certain locations is greatly reduced by use of a fixture which may be easily detached. Such a fixture made of standard parts is shown in the accompanying photograph. The fixture can be detached and replaced by a similar one, complete with clean lamp, in a few seconds by simply pulling apart the connector, unhooking the fixture and substituting a new one. Two men on a crane can change a great many fixtures within a half hour, say, during noon hour when the crane is not in use. The dirty fixtures can be lowered to the floor and conveyed to a central point to be cleaned and inspected and made ready to be installed at another point where cleaning is needed. Thus by the use of a few extra fixtures a cleaning system can be worked out which will insure efficient and economical illumination.

WHEN DIRTY THIS FIXTURE IS REPLACED BY A CLEAN ONE

These fixtures are applicable to many locations. In a great many cases the dirt and dust is of such a nature that the reflectors and lamps need to be taken down and put into a bath of cleaning solution. In industrial plants many lighting fixtures are mounted comparatively high, and in some cases they are above crane runways. They are not accessible from the floor, and the cranes cannot be stopped while a cleaner uses one of them to pass from one fixture to another, cleaning each one as he goes. Under such conditions a detachable unit like that described is particularly valuable.

J. C. RITCHEY,
Pressed Steel Car Company, Electrical Engineer.
Pittsburgh, Pa.

Careful Handling of Furnace Electrodes Cuts Production Costs

SPECIAL care in handling and storage of electric furnace electrodes is an important step in reducing production costs to the lowest point. In unloading from the car and placing in storage, or in preparing for installation in the furnace, the electrode should not be pinched around with a bar. Nor should a bar be placed in the threaded ends in attempting to lift or move it. The use of a bar usually results in surface abrasions, making it impossible to obtain the necessary electrical contact between the holder and the electrode, and if the threads are broken it will be impossible to produce a satisfactory electrode joint. Serious local heating results from either surface abrasions or imperfect joints.

In moving electrodes from cars a roller should be used. An electrode should not be slid or rolled on the car floor, as the rough surface or protruding nails will cut the electrode. After removal from the car it is advisable to handle the electrode in a rope sling with a crane. If this is not possible, it should be rolled on clean planks to avoid contamination and abrasions. Electrodes should be stored in a dry room, built to receive them and preferably located immediately adjacent to the furnace.

Tiering has been found a very satisfactory storage method. The first tier should be laid on 2-in. x 4-in. timbers placed on a clean dry floor. The additional tiers should also be placed on 2-in. x 4-in. timbers, which should properly distribute the weight and avoid unnecessary strains on the threaded ends of electrodes. Blocks should be nailed to the ends of the timbers between the tiers so that the electrodes cannot possibly roll off the pile. It is always desirable to have a crane or set of chain blocks to handle the electrodes to and from the storage pile.

This information was furnished by the National Carbon Company, Inc.

Comprehensive Meter-Test Form for Industrial Plant

A CONVENIENT meter-test form is used at the Fore River (Mass.) Works of the Bethlehem Shipbuilding Corporation, Ltd. Data are recorded on this form, which is about 8 in. x 10¾ in. in size, showing the full nomenclature applying to each meter, spaces for preliminary and final light-load and heavy-load test readings

KILO-WATT HOUR METER TEST REPORT

Tested at Fore River Plant

Location Old power house Service frequency changer Mfr. (Sangamo) Westinghouse
Meter No. 2811150 Class Cat. No. Type H Form
Voltage 2300 Amperage 200 Phase 3 Cy-les 60
Master meter disk K. 1/4 Other Data AT. 80% C.T. 40/1

Reading 5010 Dial K. Disk K. 333⅓ Gear Ratio
Does creep at volts
Fill run on lights of C.P.

LIGHT LOAD - Preliminary

Revolutions Master:	Meter on:	Seconds:	Amperes:	Voltage:	Watt Hours Actual:	Watt Hours Recorded:	Percent Fast:	Percent Slow:	
Meter	Test								
2.50	4		½	110				0.0	
2.50	4		½	110				0.0	
2.50	4		½	110				0.0	Average 100

LIGHT LOAD - Final

			left as found						
									½ Average

FULL LOAD - Preliminary

Revolutions Master:	Meter on:	Seconds:	Amperes:	Voltage:	Watt Hours: Actual:	Watt Hours: Recorded:	Percent Fast:	Percent Slow:	
Meter	Test								
3.96	16		5	110			0.7		
3.97	16		5	110			0.5		
3.98	16		5	110			0.2		Average 100.2

FULL LOAD - Final

			left as found						
									Average

	As Found:	As Left:		As Found:	As Left:		As Found	As Left:		As Found	As Left:
Seal	O.K.	O.K.	Jewel	O.K.	O.K.	Brushes			Magnets:	O.K.	O.K.
Arm			Disk	O.K.	O.K.	Window	O.K.	O.K.	Cover	O.K.	O.K.
Board	O.K.	O.K.	Shunt Fd.			Pivot	O.K.	O.K.	Comm.		
Dial	O.K.	O.K.	Shaft	O.K.	O.K.	Reading	5010	5010			

REMARKS External wires are taped in with 2300 v. mains, or secondaries with primaries. Wires to meter are very short, hard to cut in to Test.

Tested By Prescott

Date Dec. 13, 1920

THIS FORM WILL RECORD INFORMATION FOUND ON TESTING WATT-HOUR METERS

with percentages fast or slow, and a set of checking or "O.K." spaces for recording the condition of all important parts, such as seal, jewel, cover, etc., upon beginning and ending inspection. Below are spaces for comments on unusual conditions.

Boston, Mass. FIELD EDITOR ELECTRICAL WORLD.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Second Series of "Kilo Watt" Pamphlets Carries Good-Will Message

ENCOURAGED by the reception accorded to the first "Kilo Watt" series and by the manner in which the idea was accepted by the public, a second series has been prepared by the Public Relations Section of the National Electric Light Association. "The Genie of the Button" is the interesting title of the new series, which consists of six pamphlets as shown in the accompanying illustration. In the second series the good-will message on financing, regulation, taxation and self-interest is

THE GENIE OF THE BUTTON
KILO WATT Chapter 1
THE GENIE OF THE BUTTON
KILO WATT Chapter 2
THE GENIE OF THE BUTTON
KILO WATT Chapter 3
THE GENIE OF THE BUTTON
KILO WATT Chapter 4
THE GENIE OF THE BUTTON
KILO WATT Chapter 5
KILO WATT Chapter 6

SECOND SERIES OF SIX "KILO WATT" PAMPHLETS

carried out broadly on the foundation built up in the first "Kilo Watt" pamphlets. It follows closely the national campaign for public utility good will, thus affording the electric light and power companies an effective means of tying their local advertising in with the national publicity.

The first series of "Kilo Watt" pamphlets achieved a success far beyond expectations, the extent of which may best be judged from the fact that nearly 7,000,000 of them were distributed, reaching more than 1,100,000 electric light and power customers, or more than 5 per cent of the homes throughout the country.

Already orders have been received for the second series, some from companies which ordered and others from companies which did not order the first series but desired the second. Like the first "Kilo Watt" pamphlets, these are designed for distribution with customers' bills or through counter distribution and with appliances sold.

Newspaper Warns Against Home Repairing of Electrical Appliances

ELECTRICAL appliances which receive only ordinarily careful treatment as they perform their duties about the household get out of order at remarkably infrequent intervals. When something does go wrong a competent repairman can, as a rule, correct the trouble in a few minutes. Sometimes, however, he finds that the appliance has developed troubles which have not been caused by ordinary use, wear and tear or even accident. Such cases usually can be traced to a complication of the original difficulty by the tinkering of that handy man about the house—the "home mechanic."

Warning owners of electrical devices against attempting to make repairs on appliances about which their knowledge is limited at best, the Cleveland *Plain Dealer*, under the heading "'Home Mechanic' Courting Trouble," recently printed the following pertinent comments:

"If something goes wrong with your electric cleaner, don't pry open the motor with a chisel and hammer or try to adjust the commutator with a kitchen fork.

"An electrical man warns against the danger of ruining appliances by tampering with motor, contacts and gears. The amateur home electrician frequently does a great deal of harm in this way, he declares.

"'Moreover,' he says, 'the owner of the electric appliance should take note that such tampering in most cases cancels the manufacturer's guarantee. Electrical devices are usually protected by the promise of the maker to replace or repair any parts which give out within a specified period of time—unless such defects are caused by accident or misuse.

"'If the machine happens to stop for any trivial reason, it is usually a simple matter for an expert to adjust it unless some one, acting in ignorance, has made matters far worse by tinkering. Hence this misuse of the appliance forfeits the right of the owner to the protection of the manufacturer's guarantee.'

"The delicately adjusted fan of the electric cleaner may easily be thrown out of line by the home mechanic. To tamper with the motor commutator also is disastrous because nicks made in its surface are likely to cause short circuits or ruin the connection. People frequently take off the gear case of an electric washer, not realizing that the alignment of the gears is easily disturbed and that they cannot as a rule be replaced by an amateur or by one lacking proper tools.

"'It reminds me of the backwoods days when the only remedy for the toothache was to have mother pull the tooth,' said the electrical man. 'Such an attitude toward the delicate human mechanism is uncalled for of course,

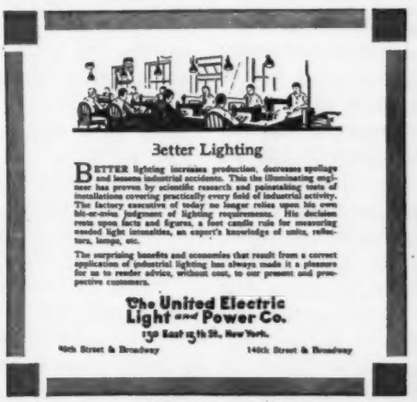
and it is just as unjustifiable in handling electrical equipment. Electrical appliances seldom go wrong, but when this happens, it is far better to call the dealer from whom purchase was made or to refer to the manufacturer than to attempt any home-made remedies.'"

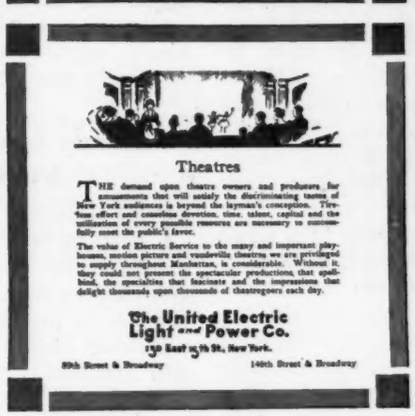
New York Company's Publicity Promotes Good Will of Public and Consumers

TO SHOW the vital connection and importance of central-station service to many of New York's industries and indirectly to the public which these industries serve, the United Electric Light & Power Company has used a series of fifteen advertisements in the New York newspapers during the past month. Four advertisements typical of the series are shown here.

An effective good-will appeal has been carried through the advertisements by directing the public's attention to the importance of the service rendered by various industries and trades and showing how the United company's electric service enables these industries to maintain a high degree of operating efficiency and service to the public. This type of publicity in addition to advertising the company's service advertises that of its customers as well, regarding which Ralph Neumuller, advertising manager of the United Electric Light & Power Company, said:

Temporary Electric Service.
THE amazing rapidity with which modern construction is completed nowadays is indeed a tribute to architectural and building genius and skill. High realty values, enormous investments and the urgent need for housing, especially in Manhattan, make the prompt tenancy of structures, once they are started, an economic necessity.
Electric Service is essential to almost every building operation. It operates concrete mixers, hoists and cranes; and affords flood lighting possibilities for rush work at night. Even though Electric Service requirements are often only temporary during construction, we are always pleased to supply our service when it is needed.
The United Electric Light and Power Co.
130 East 15th St., New York.
59th Street & Broadway
14th Street & Broadway


Better Lighting
BETTER lighting increases production, decreases spoilage and lessens industrial accidents. This the illuminating engineer has proven by scientific research and painstaking tests of installations covering practically every field of industrial activity. The factory executive of today no longer relies upon his own hit-or-miss judgment of lighting requirements. His decision rests upon facts and figures, a foot candle rule for measuring needed light intensities, an expert's knowledge of units, reflectors, lamps, etc.
The surprising benefits and economies that result from a correct application of industrial lighting has always made it a pleasure for us to render advice, without cost, to our present and prospective customers.
The United Electric Light and Power Co.
130 East 15th St., New York.
42th Street & Broadway
14th Street & Broadway


Theatres
THE demand upon theatre owners and producers for amusements that will satisfy the discriminating tastes of New York audiences is beyond the layman's conception. Tireless effort and ceaseless devotion, time, talent, capital and the utilization of every possible resource are necessary to successfully meet the public's favor.
The value of Electric Service to the many and important playhouses, motion picture and vaudeville theatres we are privileged to supply throughout Manhattan, is considerable. Without it, they could not present the spectacular productions, that spellbind, the specialties that fascinate and the impressions that delight thousands upon thousands of theatregoers each day.
The United Electric Light and Power Co.
130 East 15th St., New York.
59th Street & Broadway
14th Street & Broadway

TWOFOLD GOOD-WILL PUBLICITY

ARTIFICIAL ICE COMPANY
ICE
ICE
Ice and Refrigeration
SAFEGUARDING the public's health by providing adequate refrigeration and ice facilities for the preservation of its food products, is the monstrous task and responsibility that rests upon the ice and refrigerating companies of this city. So unfailing is their manufacture and distribution that we have come to accept this daily service as commonplace, with never a thought of its possible interruption.
The supply of Electric Service to twenty-one plants in Manhattan for the refrigeration of 10,000,000 cubic feet of cold storage space and the manufacture of 2,500 tons of ice each day, is this Company's gladly assumed portion of that responsibility.
The United Electric Light and Power Co.
130 East 15th St., New York.
59th Street & Broadway
14th Street & Broadway

"We have found that advertising of this nature creates a considerable amount of good will. It establishes a human bond between the public and ourselves and promotes friendly relations with our largest consumers, who are, of course, appreciative of desirable reference to the importance and faithful operation of their business."

The eleven other advertisements of the series dealt with the following subjects: Shops and stores, woodworking, laundries, electric signs, paper boxes and containers, dyeing and cleaning, confectioners and bakers, smelting and refining, machine shops, electric cooking appliances and electric household appliances.

Another series of twenty-five advertisements covering all phases of house wiring essential to the most complete use of electric service has been prepared by the United company and will appear in the daily newspapers during the next ten weeks.

Merchandising by a Small Central Station

POSSIBILITIES and results obtained from merchandising by a small central station serving a community of 28,000 people, and through transmission lines about a dozen small towns, were given in a paper, "Merchandise Service and Its Possibilities," by D. W. Snyder, general manager of the Bloomington & Normal (Ill.) Railway & Light Company, before the joint convention of the gas, electric and railways associations of Illinois held in Chicago March 15 and 16. In describing how the merchandising department was conducted Mr. Snyder said:

"The operating plan of the central station referred to provides for a local manager in each town or group of towns. The maintenance of adequate service demanded a local man. These men, in order to perform their varied duties, must be versatile, and necessarily earn good wages. Their work incident to the operation of the electric utility requires only a portion of their time, and the rest is available for other duties. In many of the small towns there is no other agency available to handle electrical merchandise work as the total business in a community of approximately 1,000 people cannot support an independent electrical shop. The electrical energy sales cannot provide sufficient revenue for a living wage for the local manager and leave a return to the company. The natural outcome of the situation was the utilization of the spare time of the local managers in electrical merchandising. The company doing a merchandising business in a dozen small towns naturally must maintain a central stock at its central establishment, and there also would engage in an electrical merchandising business.

"The merchandise business of the company was conducted jointly under the office and electric distribution departments without any well-defined lines of authority between the departments and without any aggressive merchandising policy. The result under that arrangement was that the merchandising business aided in reducing operation costs in the small towns but earned little profit.

"Early in 1919 the rising costs incident to the war, coupled with the inability to raise rates, caused the management to turn to the one department of the

business that was not regulated as to rates and did not require a great deal of new capital to develop. It was decided to establish a merchandise department in charge of a commercial manager, who would rank with the other department heads. This department handled all merchandising and new business except certain types of industrial motor business which are still under the jurisdiction of the electric distribution department.

"The merchandise department based its policy on the following principles: (1) Not to do house wiring in the large towns where there were electrical dealers to handle this class of work; (2) to sell only those appliances which were meritorious and would stay sold; (3) to co-operate with local electrical dealers and maintain fair prices; (4) so to conduct the merchandise department that electrical energy sales would be increased, the use of electricity popularized and the service bettered.

HIGH RATE OF STOCK TURNOVER

"The results in 1919 were highly satisfactory. New records for sales volume, net profits and meter customers were made. The fiscal year 1920 showed still better records than the previous year. The daily sales averaged about $500 per day and the net revenue earned was $36,244.50, from which should be deducted $9,153.85, covering advertising and new business development expense, which is charged to the merchandise department to offset office rents and other items of general overhead. In addition to the above earnings the merchandise department made possible many savings in operating expense. The average merchandise stocks amounted to $28,000, which include small stocks in each town. This stock was turned over five and a quarter times in 1920. In addition, approximately $25,000 was tied up in accounts receivable, some being on time payments on which interest is charged. This is partially offset by accounts payable. The accounts receivable on time-payment plans could have been discounted through the Morris Bank plan or a similar arrangement. The company carried them itself, and it takes a surprisingly short time to create a revolving fund sufficient to carry these accounts.

"The following results, attained last year in a small town of 1,300 population, indicate the value of a merchandise department to the central station:

Article	No. Sold	Receipts
Vacuum cleaners	24	$1,563.25
Washing machines	11	1,544.00
Heating appliances	56	902.20
Fans	3	84.00
Motors	6	390.00
Lamps, wiring, etc.	..	3,499.41
Total		$7,982.86
Expense		5,437.60
Gross profit		$2,545.26
Less:		
Advertising (local)	$208.00	
Part commercial manager's wages	155.00	
Miscellaneous expense	120.00	483.00
Net profit		$2,062.26
Local merchandise stock (average)		950.00

"This statement is somewhat misleading as to capital invested in merchandise stock as the local stock was kept small compared with the volume of sales owing to the fact that the central stock was called upon when needed.

"The method of handling the merchandise department is comparatively simple. The commercial manager, by means of sales talks, educational letters and tabulated reports of business done in each town, keeps up enthusiasm and a spirit of friendly rivalry. All members of his staff are paid regular monthly salaries except vaccum-cleaner salesmen, who operate under the "Hoover plan" and are paid commissions only. Nearly each month a campaign in some leader is put on, but rarely, if ever, is a cut price the feature of the campaign.

"Advertising, backing up personal solicitation, is the most important part of the sales promotion work. Approximately 4 per cent of the gross sales is spent in advertising, the major portion going to the newspapers.

"Certain contractor-dealers thought the program of advertising was aimed at them and voiced their complaint to the manager of the central station. His explanation was that the advertising was not directed against them, but to draw the buying power of the public into the electrical trade. They were urged to increase their advertising, not in the spirit of competing against one another, but of the electrical trade competing against the field. The combined sales of the contractor-dealers also showed a healthy increase in 1920, which we believe proves the truth of the theory. This same advertising, some being quite general in its nature, was reflected in the demand for new services. No special inducements were held out to new customers as the company did not wish to increase its capital account. Connection rules and charges were rigidly enforced. In spite of these conditions more meters were installed than in any previous year, the gain in meters being 1,138, or 14 per cent on the entire property.

"The merchandising department is a fertile place for complaint, but is just as fertile a place to make friends for the central station. It is our belief that a central station owes it to its customers to maintain a properly organized merchandising department, not as a competitor of the contractor-dealer but to co-operate with him to serve properly the existing electrical needs and to develop the almost untouched field before us."

Steady Growth of Business Reported by Byllesby Subsidiaries

THE standard Gas & Electric Company's annual report, to be issued shortly, will show that the company's utility subsidiaries are now serving nearly 500,000 customers, having connected approximately 1,000,000 hp. in lighting, heating and power devices. It is estimated that during the year 1921 these customers will consume more than 1,000,000,000 kw.-hr.

A tabulated record of the subsidiaries' connected load growth from 1914 to date in two-year periods follows:

Year Ended Dec. 31	1914	1916	1918	1920
Electric customers	169,412	211,071	256,454	317,452
Gas customers...	120,629	130,204	144,690	157,572
Lighting and power business served (in hp.).	465,653	596,632	771,261	962,891
Kilowatt-hour output	380,212,118	488,982,265	691,097,366	874,306,424
Miles electric pole lines	4,789	5,590	7,041	7,983

In this six-year period the number of electric customers nearly doubled, the horsepower equivalent of the customers' installations more than doubled and the kilowatt-hour output increased 130 per cent. To serve this business the company increased its distributing facilities (electric pole lines) only 66 per cent, indicating the greater extent to which customers on established lines are utilizing electric service for their daily needs.

Digest of Electrical Literature

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Delta-Star Motors for Agricultural Use.—H. ROTH.—It is customary to use a 15-kw. to 20-kw., three-phase motor dimensioned for driving threshing machines and for small farm machinery, as this requires comparatively little power, and investment in a second, smaller motor is infrequent. This means a lower efficiency and a poor power factor. The author suggests winding such motors in open delta and operating them for full power in closed delta and for small power requirement in star. For example, a three-phase motor, delta-connected, will give 15 kw., and the same motor star-connected about 5 kw., operating in both cases with about 89 per cent efficiency and at 0.9 power factor. The same 15-kw. motor loaded with only 5 kw. with delta winding would operate with only 81 per cent efficiency and at 0.75 power factor. A tabulation of segregated losses, derived by means of the Heyland circular diagram method, is given.—*Elektrotechnische Zeitschrift*, Jan. 13, 1921.

Standardized Electric Motor Manufacture.—A discussion of the standardization in motor manufacture as established by one British firm.—London *Electrician*, Feb. 25, 1921.

Generation, Transmission and Distribution

Applications of Electric Power on Modern Gas Undertakings.—H. C. WIDLAKE.—The modern gas works, with their many power-using units scattered over a wide area, offer a peculiarly suitable field for the application of electric power. Until recently single-cylinder non-condensing steam engines were in common use, fed by a network of pipe throughout the works. At present, however, the gas-works plant convertible to electric drive includes charging and discharging machines, conveyors, telphers, elevators, cranes, hoists, exhausters, compressors, blowing and gas-boosting fans, pumps, washers, disintegrators, agitators, hydro-extractors, electro-tinning plant, machine tools and wood-working tools. The distribution of the total output of electricity among the various classes of apparatus in the cases discussed in the article was as follows: Coal-handling plant, 30.9 per cent; coke-handling plant, 19.1 per cent; purification plant, 24.1 per cent; water-gas plant, 17.6 per cent, and machine tools, lighting, etc., 8.3 per cent.—London *Electrician*, Jan. 14, 1921.

Inductive Grounding in Systems with Unsymmetrical Capacity Distribution. — JONAS. — When a flashover occurs on an insulator a power arc is often started, which may keep going until the insulator is seriously injured. The tendency to devolop such power arcs is greater in systems with larger capacity. Professor Petersen, in Darmstadt, Germany, recently has shown that if the transformer neutral is grounded through a choke coil of such inductance as to give resonance with the line capacity at the working frequency then the arc will be almost immediately extinguished, since the current discharged from the line and the inductive current in the neutral-point grounding coil will almost exactly cancel, leaving a very small current in the arc. The inductive grounding coil is patented and is marketed by the A. E. G. The present author, however, questions the usefulness of Petersen coils in many practical cases where the capacity to ground of the different phases is never exactly alike, and shows that in unsymmetrical systems the grounding coil may give rise to very large voltages from neutral to ground when the system is in normal operation. The conclusion is that, contrary to the Petersen proposal, the inductive grounding coil should be decidedly out of tune with the line capacities in order to avoid such complications. Definite suggestions are made as to the most advantageous amount of inductance in different cases, and the author also discusses the effectiveness of a non-resonant grounding coil. It turns out that the coil will very effectively stop the arcing even when enough out of tune to prevent voltage rises during operation. — *Elektrotechnik und Maschinenbau*, Vol. XXXVIII, page 453.

Optimum Conditions of Transmission Economy.—BATICLE.--One difficulty encountered when attempting to apply the Kelvin economical rule to practical problems of transmission is the necessity to determine beforehand a price for the energy lost in the transmission line. This price corresponds neither to the self-cost at the generating plant nor to the sales price, nor can it be considered independent of the economy of transmission. The author, therefore, in attempting to derive some rational economical rules, puts as a fundamental requirement that the self-cost per kilowatt-hour at the receiving station shall be a minimum. On this basis he derives the following rules for a given percentage loss of transmission: (1) For a given efficiency of transmission the voltage should be such that the cost of the conductors is equal to the cost of the insulation multiplied by $n/2$, where the insulator cost is assumed to be proportional to the nth power of the transmission voltage; (2) if the voltage is given the transmission efficiency should be such that the cost of the conductors is to the total cost in the same proportion as is the average loss to the average received power; (3) assuming cost of insulation to be simply proportional to the transmission voltage rather simple expressions are derived wherein voltage as well as efficiency are variables. The rules are applied to practical transmission cases and appeared to lead to quite reasonable results.—*Revue Générale de l'Electricité*, Vol. VIII, page 595.

Traction

Renewal of the Catenary Construction in the Hoosac Tunnel.—L. C. WINSHIP.—Nine years of exposure to gas, moisture and corrosive solutions from the tunnel roof have been sufficient to destroy the copper messenger which was installed in the Hoosac Tunnel at the time of electrification in 1911. The construction of the new

messenger is shown to give promise of even longer life.—*Electric Journal,* March, 1921.

Economical and Constructive Viewpoints for Large Electric Locomotives.—ALB. LATERNSER.—The author compares the following recently built electric locomotives: (1) General Electric freight type for Chicago, Milwaukee & St. Paul, direct current; (2) General Electric express type for Chicago, Milwaukee & St. Paul, direct current; (3) Westinghouse freight type, Pennsylvania Railway, alternating current; (4) Westinghouse express type, Chicago, Milwaukee & St. Paul, direct current; (5) Oerlikon freight type, Swiss Federal Railways, alternating current; (6) Oerlikon express type, Italian State Railways, three-phase. The comparisons are made entirely from the European standpoint, the author being a Swiss. Comparing the geared and the gearless type, the low center of gravity of the latter and the decreasing gear efficiency with increasing speed of the former are disapproved. The high amount of unsprung load of the types Nos. 1, 3 and 4 is mentioned, resulting in undue wear of rails. Attention is called to the disagreement of the two leading American firms as to the construction best suited to both the express and the freight types of heavy locomotives. The two European types, Nos. 5 and 6, represent the most powerful locomotives used abroad, and are both equipped for regenerative braking. The American direct-current regenerative system is considered very complicated and not fully reliable. The whole electrical equipment of the American types is held to be complicated, and the number of economic controller positions is thought inferior to the corresponding feature of the Swiss federal locomotive type.—*Schweizerische Bauzeitung,* Jan. 29, 1921.

Installations, Systems and Appliances

Swedish Electric Pig-Iron Furnace.—JONAS HERLENIUS.—A brief description of the constructional details, methods of starting and operation of these electric furnaces. The following table gives results during the first seven months of 1920 from the operation of a large plant of several units having a transformer capacity each of 3,000 kva. to 4,000 kva.:

	Furnace 3	Furnace 5
Total amount of ore used, tons	5,733.20	6,310.41
Total amount of lime used, tons	568.74	742.80
Total amount of ore and lime used, tons	6,301.94	7,053.21
Total amount of charcoal, lb.	2,957,440	3,112,640
Total amount of current, kw.-hr.	9,576,200	9,001,700
Operating time, hours and minutes	3,736 05	2,989 35
Idle time, hours and minutes	167 45	97 25
Total time, hours and minutes	3,903 50	3,087 00
Produced pig iron:		
Open-hearth, tons	365,670	3,483,275
Bessemer, tons	3,307,585	
Total tons	3,673 255	3,483,275
Relative figures:		
Electrodes, lb. per ton pig	17.6	19.3
Charcoal, lb. per ton pig	20.1	22.3
Electric current, kw.-hr. per ton pig	2,605	2,580
Average load in kw.	2,565	3,020
Pig iron per day in tons	22.5	27.1
Per cent pig of ore charged	64.2	55.25
Per cent pig of total charge	58.3	49.40
Lime in per cent of ore	9.95	11.75
Idle time in per cent of operating time	4.47	3.23

"Ton" means metric ton of 1,000 kg., equal to 2,205 lb. (approximately 1 long ton.)

The total present cost in the United States of a complete electric pig-iron plant with one furnace of 4,000-kva. transformer capacity is estimated at about $150,000.—*Chemical & Metallurgical Engineering,* Vol. XXIV, page 108.

Electric Welding Progress.—NEUBERGER.—The author discusses recent developments in electric machine welding and deals in detail with the method of seam welding in machines with rolling electrodes. It was found at an early date in the history of electric welding that rolling electrodes with a continuous rolling motion will burn the plates to be welded. In recent seam-welding machines the plates are carried forward stepwise between the rolling electrodes, while at the same time the current is interrupted by an automatic device so that no current is flowing when the motion takes place. The author describes different types of seam-welding machines operating upon this principle and states that thin white sheet iron may be welded by this method without even the tin covering being burned, while on the other hand reliable joints may be welded with rolling electrodes when the thickness of the plates to be welded amounts to as much as 8 mm. or 10 mm. (⅜ in.). Another development in electric welding with stepwise rolling electrodes is the automatic tube-welding machine built for welding tubes up to 10 m. (33 ft.) long, of plate up to 10 mm. (⅜ in.) thick. There are also smaller types of tube-welding machine which turn long ribbons of plate into welded tubes of indefinite length. The capacity of these machines is from 300 m. to 600 m. (1,000 ft. to 2,000 ft.) of tube a day.—*Elektrotechnik und Maschinenbau,* Vol. XXXVIII, page 571.

Electrophysics and Magnetism

Electrical Resistance of Metals.—P. W. BRIDGMAN.—The paper contains a brief summary of an extensive series of measurements, which are to be published later, made to determine the effect of pressure up to 12,000 kg. per square centimeter and of temperatures from 0 deg. to 275 deg. C. on the resistance of lithium, sodium, potassium, gallium, bismuth, mercury, calcium, strontium, magnesium, titanium, zirconium, arsenic, tungsten, lanthanum, neodymium, carbon (amorphous and graphitic), silicon and black phosphorus. The data for tungsten and magnesium are said to be improvements over data previously published, and the data for the other substances are new. The first six of the elements mentioned were studied in both the liquid and the solid states. A previous theoretical discussion concerning measurements of the effect of pressure on resistance suggested most strongly that in metallic conduction the electrons pass through the substance of the atoms and that the mechanism by which resistance is produced is intimately connected with the amplitude of atomic vibration. This view is here given quantitative form.—*Physical Review,* February, 1921.

Einstein's Principle of Relativity and Its Bearing Upon Physics.—JOSEPH S. AMES.—The author says that experience of more than 100 years has confirmed the general belief in the accuracy of Newton's laws. There is, however, one feature of universal gravitation about which there was no knowledge in Newton's day, or even in our own till very recently. This is the question as to whether the law of gravitation differs as between bodies moving slowly and those moving rapidly. The greatest velocity known is that of light, about 186,000 miles per second, and in comparison with this the velocities of the planets may in general be called small. Thus it is perfectly possible that Newton's law is a statement of fact for bodies moving slowly but requires modification in case they are moving rapidly. This now appears to be the case, since there is knowledge of the action of gravitation in the case of great velocities and Newton's law does not express the facts. Moreover, Einstein has

proposed a law which does correspond in a wonderful manner with these and all known facts. The article asserts that Einstein has not disproved Newton's law but has simply described the limitations within which it holds. Some of the consequences of this theory are discussed by the author.—*Journal Franklin Institute*, January, 1921.

Electrochemistry and Batteries

The Electrodeposition of Metals.—W. E. HUGHES.—This is the third article of a series and deals particularly with the preparation of the work. Methods of cleaning are classified and taken up as follows: (1) Mechanical, (2) chemical and (3) electrochemical. It is said that usually two of these methods must be employed in any case—the mechanical and either of the other two. Detailed methods of cleaning iron, brass and other metals for electroplating are considered in detail.—*Beama (British Electrical and Allied Manufacturers' Association)*, February, 1921.

Units, Measurements and Instruments

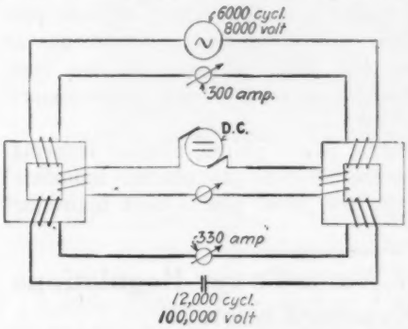
Errors of Direction Finders.—Dr. E. BELLINI.—The discovery of the amplifier is held to have enormously extended the range of direction finders, and the adoption of undamped waves of very great length also helped to change their working conditions completely. The extension of the ranges to enormous values, however, has developed new sources of errors which can be attributed neither to the conditions of the earth's surface nor to the influence of neighboring bodies. The characteristics of the new errors are especially their magnitude and their variability. Minimum in the daytime, they become larger at sunset and reach their maximum at night, becoming sometimes enormous, as much as 50, 60 and even 90 deg. Their rate of change may reach several degrees per minute. The author undertakes to demonstrate that these errors are due both to the reflection of waves from the Heaviside layer, considered as homogeneous and continuous, and to the influence of the horizontal parts of the sending antennas uppon the horizontal parts of the receiving loops.—London *Electrician*, Feb. 18, 1921.

The Whitened Cube as a Precision Integrating Photometer.—H. BUCKLEY.—The paper indicates how a whitened cube can be made to give accurate results when used in the determination of the average candlepowers of lamps having different polar distributions. As a preliminary the relative effects of different portions of the interior of the cube in producing illumination on the window are determined and the results are used to calculate the illuminations produced by different types of light distribution. The ratios of these illuminations to that furnished by a uniform point source of unit intensity give apparent average candlepowers in the cube. It is then shown by experiment that candlepowers obtained by the usual methods of integrating photometry agree with these calculated values. Thus it is possible to determine by how much these apparent candlepowers differ from true candlepowers deduced by point-to-point methods, and hence to obtain true candlepowers from experimentally determined apparent values. In the special case where a comparison is made between lamps having identical polar distributions it is shown that the usual method gives accurate results.—*Journal Institution of Electrical Engineers*, London, January, 1921.

Telegraphy, Telephony and Signals

Morse Printing of Wireless Signals.—B. S. T. WALLACE.—The writer deals with apparatus that can be applied to the printing of signals received by wireless in such a way that the operation is automatic.—*Wireless World*, Feb. 5, 1921.

The High-Power Wireless Station at Nauen.—FELIX LINKE.—A very elaborate and profusely illustrated article on the development and present equipment of the famous Nauen station. The history of the station is at the same time the history of the art of wireless telegraphy and telephony. All systems invented and developed in the past fifteen years have been tried out on a large scale in this station, which now covers an area a hundred times greater than the original one. Four distinct periods have been gone through in this station: 1906-1909, open-spark system (Knallfunken) with 10-kw. antenna energy; 1909-1911, quenched spark (tonende Loschfunken), with 25-kw. and 35-kw. antenna energy; 1911-1916 (a) same as before with 80-kw. and 100-kw., (b) high-frequency machines of 100-kw. antenna energy; 1916 to present day, high-frequency machines of 400-kw. and 150-kw. antenna energy. The height of the original tower, 100 m., was increased to 200 m., but the tower was blown down by a heavy storm. A new tower of 260 m. was then erected. The Telefunken company, operating the Nauen station, built in 1913 the Sayville plant and opened regular commercial communications between America and Germany, thus antedating the efforts of the Marconi company to establish communication between England and the United States. The high-frequency current is generated by the Arco system, first suggested by Jolly for the doubling of 50 cycles alternating current (see sketch).



PRINCIPLE OF MULTIPLYING-FREQUENCY SYSTEM JOLLY ARCO

The main generator is rated at 6,000 cycles, 1,500 r.p.m. It has 240 teeth and 480 slots. By means of a cascade arrangement of direct-current-influenced static transformers a final frequency of 24,000 cycles is obtained. This generator and transformer set have been used continuously for the last four years without any trouble of any kind. It is claimed that such a record cannot be achieved by any other known system. Electric data for the transformers, such as efficiencies, losses and heating, are given. The transformers are oil-cooled.—*Zeitschrift des Vereines Deutscher Ingenieure*, Vol. LXIV, page 973.

Miscellaneous

The Question of Current Rates for Inductive Loads.—F. SCOUMANNE.—Six different methods for determining satisfactory rates for inductive loads are given and criticised. By means of analytical investigations along purely mathematical lines the author arrives at a formula which permits of a very exact and just kilowatt-hour rate.—*Revue Générale de l'Electricité*, Jan. 1, 1921.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Utilities Asked to Report on Coal Stocks

ELECTRIC power plants and other large consumers throughout the country have been asked by the United States Geological Survey to report the stock of coal on hand as of Jan. 1 and as of March 31. In addition, these plants are asked to answer the question, "What should be your normal stock as of March 31?" The survey, which issues a weekly report on coal production and movement and on operating conditions at the mines, has long felt that the report is not complete without information as to the state of consumers' stocks.

In addition to electric power plants, similar information is being requested of coal-gas plants, industrial plants, retail coal dealers, steel plants and byproduct coke plants.

Agreement on Water-Power Regulations Expected Soon

AN AGREEMENT probably will be reached this week between the representatives of the National Electric Light Association and Federal Power Commission officials in the matter of regulations. Objections to the regulations as promulgated have been many and the questions involved are intricate. As a result the conferences have extended over more than two weeks. No announcement will be made of the changes which already have been agreed upon until a final decision is reached in regard to all matters at issue.

Foundation Laid for American Engineering Standardization

ORGANIZED for active work somewhat more than a year ago, the American Engineering Standards Committee has already assumed an important rôle in co-ordinating the work of more than a hundred organizations already engaged in the development of engineering standards. Of especial significance to electrical engineers is the work in progress on "rating of electrical machinery," sponsored by the American Institute of Electrical Engineers, and "terminal markings for electrical apparatus," sponsored by the Electric Power Club, as well as the "Electrical Fire Code" and the "Electrical Safety Code." These matters are discussed in the annual report of the American Engineering Standards Committee, which will soon be published. A. A. Stevenson is chairman and P. G. Agnew is secretary of the committee.

The "main committee" is made up of forty-seven members, representing seventeen bodies, including six national societies, five government departments and thirteen national industrial associations. Its purpose as emphasized in the report is not to dominate but to serve. Thus the "main committee" occupies itself with policy matters and co-ordination work, leaving to the "sectional committees" the actual technical problems. The sectional committees are organized by one or more of the principal bodies interested in any particular work, with the approval of the main committee, such "sponsor bodies" assuming leadership in the actual development of standards.

President Harding Indorses Electrical Expositions

ON TUESDAY, April 19, and the four following days the Duluth (Minn.) Society for Electrical Development will hold an exposition in the city's armory, at which an attendance of 25,000 persons is expected. Besides the manufacturers' displays there will be electrical spectacles and other attractions. President Harding has written to the promoters of the show as follows:

"On the occasion of the electrical exposition which the Society for Electrical Development is to hold in Duluth will you please extend my greetings and good wishes to the organization and my hopes that the exposition may be fully successful. America has always been a leader in electrical science, and such expositions as you are holding are sure to prove valuable contributions toward maintaining our national position."

Rating of Machinery Discussed by Standards Sub-committee

FIVE subjects of considerable importance to motor users as well as manufacturers were discussed at the two days' meeting in New York on March 31 and April 1 of the sectional committee of the American Engineering Standards Committee on rating of electrical machinery. The subjects were (1) single-temperature versus double-temperature basis of rating all classes of electrical machinery, (2) safe temperature limits for class A insulation, (3) ambient temperature, (4) temperature gradient, and (5) methods of temperature measurement.

While the discussion, which was informal, did not result in any agreement, it appears more likely than ever that supporters of opposite views will be brought together on a mutually agreeable basis. It was quite generally held that the hot-spot temperature at the hottest spot in machinery with class A insulation should never exceed 105 deg. C., although no definite agreement was reached.

The sectional committee which discussed the foregoing subjects is composed of delegates from the American Institute of Electrical Engineers, the National Electric Light Association, the Association of Edison Illuminating Companies, the Electric Power Club, the American Mining Congress and the American Institute of Consulting Engineers. The opportunity to have representation on the committee has been given to other

national associations, but they have not yet taken advantage of the invitation.

Another meeting has been called for May 5 and 6, at which each member of the sectional committee will be expected to present specific data and facts on which decisions can be based. Prof. Dugald C. Jackson is chairman of the sectional committee, L. L. Elden is vice-chairman, and Dr. A. S. McAllister is acting as secretary.

General Electric's 1920 Billings $275,000,000

SALES billed amounting to $275,758,487 in 1920 are shown in the twenty-ninth annual report of the General Electric Company just issued—an increase of $45,778,504 over those for 1919. The net value of orders received was $318,470,438 as against $237,623,932 for 1919. At the end of the year the amount of orders unfilled, after eliminating all cancellations, was $111,778,000, compared with $98,880,000 at the close of 1919. Reduction of inventories to market values of Dec. 31, 1920, amounted to $17,803,985.

The unprecedented volume of orders received during the first seven months of the year, plus unfilled orders at the beginning of the year, resulted in more urgent efforts, in a difficult situation, to add to manufacturing facilities, and during the year the company added 2,052,000 sq.ft. of owned factory floor-space and 1,768,000 sq.ft. leased with option to purchase. Present manufacturing space amounts to 24,501,000 sq.ft.

At the close of 1920 inventories at factories amounted to $93,574,114 and at warehouses, in transit, on consignment, etc., amounted to $24,535,059, a total of $118,109,174, as against $83,978,463 at the close of 1919. The item of customers' accounts and notes receivable, carried at $64,962,682, which is an increase of $19,077,154 over the balance shown on Dec. 31, 1919, is an indication of the way bills are being paid. Total outstanding capital stock at that date was $139,026,900.

National Electrical Safety Code Now Available

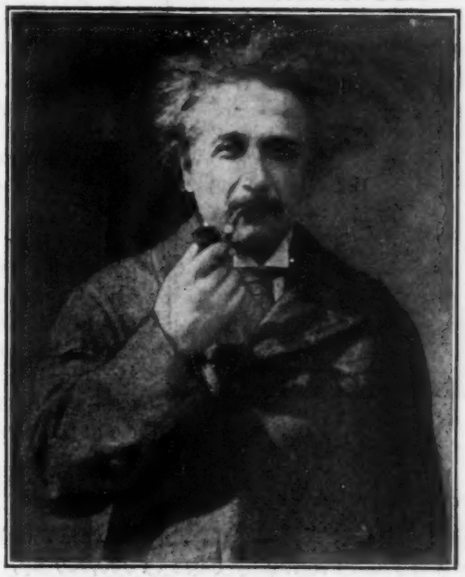
THE third edition of the National Electrical Safety Code, prepared by the Bureau of Standards, Washington, D. C., and known as Handbook No. 3, has just been issued.

The greatest changes made in this edition are in part 2, which deals with the installation and maintenance of overhead and underground service and signal lines. The loading specification, upon which are based the requirements for strength of construction, has been simplified and has been applied to signal lines crossing railways, for which arbitrary rules were formerly used. The rules have been rearranged in more convenient order, and an index has been added. The sag tables have been extended to cover iron and steel conductors.

The new edition of these rules is in pocket size and has been entirely separated from the discussion of the rules which accompanied them in the second edition. This discussion has been considerably amplified and will be published separately as Handbook No. 4, which is now in press.

Copies of Handbook No. 3 may be secured from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 40 cents per copy, bound in buckram.

Propounder of Relativity Theory Visits United States



Prof. Albert Einstein, whose theories regarding space and time have made such an impression recently upon the scientific world, photographed as he arrived in this country last Saturday on the Holland-America liner Rotterdam.

Little Hope for Texas Utility Act Until Next Legislative Session

MUNICIPAL home-rule representatives in the lower house of the Texas Legislature have by incorporating in the proposed utility act many amendments injurious to utilities forced proponents of the bill to kill it by striking out the enacting clause. This development leaves little hope for state utility relief until the next biennial session of the Legislature.

The bill was drafted by a committee appointed by the Governor and consisting of an equal number of representatives of municipalities, utilities, state commercial bodies, the State House of Representatives and the Senate. The original draft of the bill, as prepared by the representatives of the municipalities, was drastic as regarded the treatment of utilities. Many open hearings were held by the committee, however, and a greatly amended final draft was passed by a large majority referring it to both chambers of the Legislature. The bill was passed by the Senate, but in the House it ran into the snags mentioned.

Five Miles of Spectacular Mountain Highway Lighting Proposed

NEGOTIATIONS are under way between the Jefferson County Power & Light Company of Golden, Col., and the city and county of Denver for the illumination of the Williams Highway from the city limits of Golden to the summit of Lookout Mountain, a distance of approximately 5 miles. This road is part of the Denver Mountain Parks system, and if the lighting is installed it will form one of the most spectacular stretches of highway illumination in the country.

The proposed system would consist of 150 600-cp. series lamps mounted on 20-ft. posts, light centers being 18 ft. from the ground.

Hundred Thousand People to Help Finance 900,000-Hp. Project

R. H. BALLARD

TWO hundred million dollars will be needed by the Southern California Edison Company to develop and distribute power from the San Joaquin River, for which authorization has been given by the Federal Power Commission. According to R. H. Ballard, vice-president and general manager of the company, who is now in the East in connection with the financing of this project, work will start this spring on this development, which will yield eventually close to 900,000 hp. Financing, Mr. Ballard told an ELECTRICAL WORLD representative, will probably be 60 per cent in the form of bonds and the remaining 40 per cent common stock which will be sold locally.

"Common stock sold locally," said Mr. Ballard, "will be the foundation on which this immense development will rest. Up to the end of January we had sold in excess of $3,250,000 of common stock to more than 3,500 subscribers in anticipation of this work. To date we have on our books eleven thousand stockholders, and we expect eventually to have a hundred thousand locally. On the average a subscriber takes eight shares of stock."

Mr. Ballard was then asked to explain the engineering principles of this development, and he said:

"First and foremost we shall have recourse to immense storage reservoirs. Water in California is becoming more and more valuable, not only for power purposes but for irrigation as well, so that it is the part of wisdom to store all of it we can. Time was when in seasons of flood water went tearing through the canyons in its mad rush to the sea, inundating and destroying as it went. Such happenings may be impressive as scenery, but the scars left are anything but attractive. Besides, the periods of drought are far longer than the periods of flood. Now we plan to save the water and curtail the damage; hence the reservoirs.

"Under the permits that have been issued to us we shall shortly begin construction of reservoirs at Vermilion Valley on Mono Creek, a tributary of the South fork of the San Joaquin River; at Blaney Meadows and Florence Lake, on the south fork of the San Joaquin, and at Shaver Lake, on Stephenson Creek.

"These, together with the Big Creek chain, will complete the development of this diversion of the San Joaquin. There are a number of tributaries feeding into the San Joaquin divided into two sections. This development takes into consideration the upper river only. At the highest altitude, between 7,000 ft. and 8,000 ft. from Mono Creek, these waters are to be stored in Vermilion Reservoir, which has a capacity of 30,000 acre-ft. Below the dam enters Bear Creek, and its waters and the spill from Vermilion reservoir combine with waters from the south fork, after filling the 17,000-acre-ft. Blaney Meadow reservoir, to fill Florence Lake to a capacity of 50,000 acre-ft. These reservoirs will thus catch the spring floods, and the spill which otherwise would be lost is saved. Big Creek and Pitman Creek combine with the spill from Florence Lake to be stored in Huntington Lake, which has a capacity of 89,000 acre-ft. Before this, however, the Pitman Creek waters will be regulated by a 30,000-acre-ft. reservoir and Shaver Lake storing 146,000 acre-ft.

"All of this will be storage before a single drop of water passes through a wheel. It will then drop through a chain of power houses a distance of about 6,000 ft., when all of it will be available for irrigation purposes. From Huntington Lake water now goes through power house No. 1, where 32,000 kw. out of an eventual 64,000 kw. is operating under a 2,130-ft. head. Below is power house No. 2, which will eventually have 134,000 kw. capacity, with 48,000 kw. now in operation.

"With the creation of the reservoirs in the upper altitudes Huntington Lake will be able to accommodate considerably more than the present No. 1 and No. 2, so part of the water will be shunted through tunnels to Shaver Lake and power house No. 5.

"This plant, work on which will be started as soon as satisfactory financial provisions have been made, will have an ultimate capacity of 108,000 hp. and operate under a head of 1,480 ft. Its tailrace will lead into Shaver Lake, which will store also the waters from Stephenson Creek. It will have a capacity of 146,000 acre-ft. This reservoir will also feed into No. 2, or what is virtually the same, a power plant adjacent to No. 2. From No. 2 the tailrace drops 717 ft., feeding No. 8. This plant, which will ultimately be rated at 120,000 hp., will also be started this summer with 30,000 hp. From this point the water will be used as it drops in other power houses to be developed as needed.

"We believe that with this system of water control we have solved the problem of the power supply of southern California for some years to come."

Public Utilities to Exhibit at Chicago Pageant of Progress

THE education of the public on the subject of recent electrical inventions will be one of the objects of the public utility exhibit to be held at the Chicago Municipal Pier during that city's "Pageant of Progress" in July. Among some of the inventions exhibited will be the directional wireless and the wireless telephone. Demonstrations will include steering a boat by wireless, controlling pilotless aëroplanes by wireless, communicating with aviators by wireless telephone and transmission of music by wireless telephone. Manufacturers of electric appliances also will be represented.

A definite plan for an exhibit to show how the public utilities have aided the progress of the city has not been worked out yet, according to George Foster of the Commonwealth Edison Company, and W. C. Keith, city commissioner of gas and electricity, who are in charge of the exhibit, but it is understood that the utilities' part in making Chicago the second largest city in the country will be strikingly portrayed.

The section apportioned to the utilities has space for approximately forty individual exhibitors, about half of this space having been taken on April 1. Reservations are being made in such numbers, according to Mr. Foster, that there is little doubt that the whole section will be filled far in advance.

Inspectors Favor Separation of Electrical and Safety Codes

ABOUT a hundred members and guests of the Western New England Association of Electrical Inspectors convened at Springfield, Mass., March 30, Thomas H. Day presiding, to discuss wiring questions associated with the 1920 edition of the National Electrical Code. By a vote of about three to one the meeting declared itself in favor of retaining the present separation between the National Electrical Code and the National Safety Code. Following a short business meeting, the use of metal conduit in installations subjected to the fumes of animal waste, steam vapors, packing-plant drips, salt spray, etc., was discussed in person or by letter by President Day; G. E. Bruen, superintendent electrical department, Suburban Fire Insurance Exchange, New York; C. R. Hodgdon, chief electrical inspector Allegheny County Board of Fire Underwriters, Pittsburgh, and A. E. Braddell, Sprague Electric Works, New York.

The growing favor with which modern designs of safety switches and fuses are being received and some of the problems involved in protection were discussed by A. A. Packard, superintendent Connecticut Power Company, Middletown, Conn.; F. T. Wheeler, vice-president Trumbull Electric Manufacturing Company, Plainville, Conn.; B. H. Glover, associate electrical engineer Underwriters' Laboratories, Chicago, and Dr. M. G. Lloyd of the United States Bureau of Standards. An exhaustive interpretation of the grounding rules of the 1920 Electrical Code occupied the afternoon session, President Day, a member of the committee on rules for grounding, being the chief speaker.

Central-Station Service from Different Points of View

A SYMPOSIUM on central-station power service from different points of view is scheduled for the April 15 meeting of the Western Geographic Section of the Pennsylvania Electric Association at the William Penn Hotel, Pittsburgh.

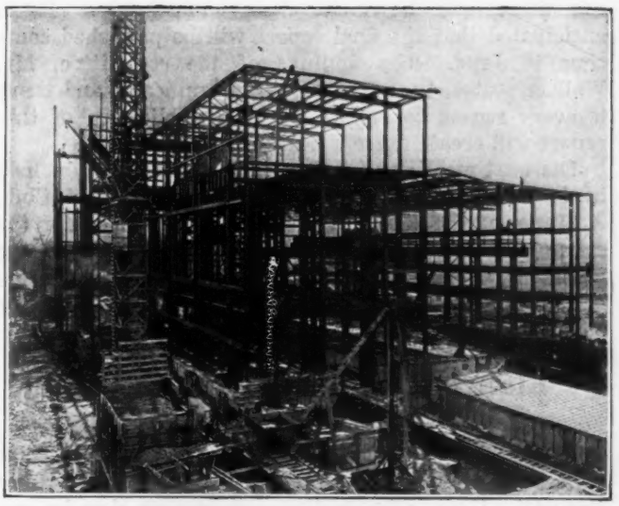
The following papers are to be presented: "The Ideal Power Customer for the Central Station," from the commercial standpoint, by G. M. Gadsby, vice-president West Penn Power Company; from the technical standpoint by E. C. Stone, assistant to the general manager of the Duquesne Light Company; "The Ideal Central-Station Power Service," by J. A. Coyle, general manager of the Universal Steel Company, from the standpoint of the steel plant, and by W. L. Affelder, assistant to the president Hillman Coal & Coke Company, from the point of view of the coal mine.

Bethlehem Steel Company Interchanges Power with Lehigh Valley Company

ALTHOUGH no interconnection contract is in existence, the generating station of the Bethlehem Steel Company, Bethlehem, Pa., has frequently carried a part of the load of the Lehigh Valley Light & Power Company, D. M. Petty, electrical superintendent of the Bethlehem Steel Company, asserted in his paper, "Generation of Power in Steel Mills," read before the Philadelphia Section of the Association of Iron and Steel Electrical Engineers on April 2. During the month of November, 1920, the steel mill supplied the power company with three times as much power as was purchased from the power company. The power purchased, observed Mr. Petty, cost the steel company between two and three times the price obtained for the power sold to the power company. However, the power bought was worth more because it was peak-load power, while that sold to the power company was simply a by-product of the steel company.

A study of steel-mill plants has shown that for the economic operation of gas-engine plants the load factor should be between 65 and 100 per cent. Below that range the steam-turbine plant shows higher economies. The logical development would, Mr. Petty continued, be a combination steam and gas station. However, as the central station would be able to handle the steam turbine at a higher continuous load factor, the most efficient arrangement which could be made would be to buy that part of the load from the power company. For this reason interconnection offers a very interesting possibility.

Hartford Plant Construction Speeded Up to Relieve Employment Situation



ACTING upon advices from S. G. Dunham, president of the Hartford (Conn.) Electric Light Company, construction work at the new "Meadows" generating plant of this organization is being pushed toward completion at the normal rate by Stone & Webster, Inc., builders of the station. In a recent letter to Stone & Webster, President Dunham said that the very great curtailment in local industrial development and consequent lesser demand for power make it unnecessary to push the new plant to completion during the present year, but in view of the amount of local non-employment, which it is for the company's interest to relieve as far as possible, and because of the greater economy to be obtained from the new plant if it should be in operation during the coming winter, the Hartford company was willing to release the hold-up orders placed last fall and allow the construction to proceed at once, provided that the work can be done economically and at a reasonable reduction from the very high wage scale prevalent last year. Accordingly the working force has been approximately doubled and the job is now proceeding on the basis of a wage reduction of about 20 per cent. Contrary to impressions prevailing outside Hartford, work on the station was not suspended during the winter but was slowed down to meet the prevailing business situation. The steel structure of the plant is now virtually finished, and two 20,000-kva. generating units are to be installed as initial equipment.

A. S. M. E. Power Test Codes Being Revised and Enlarged

REVISION and enlargement of the power test codes of the American Society of Mechanical Engineers, issued in 1915, are under way by separate code committees. In all there will be nineteen codes, by means of which all power apparatus may be tested. A main committee of twenty-eight, of which Fred R. Low, editor of *Power*, is chairman, is supervising the work of the nineteen committees.

Three of the nineteen codes will be presented to the A. S. M. E. for consideration and adoption at the spring meeting, to be held in Chicago, May 23-26. One is in the nature of a preliminary set of rules and is entitled "General Instructions," the second relates to reciprocating steam engines and the third to evaporators.

Study of Elimination of Waste Going Forward Rapidly

ALL FIELD WORK of the American Federation of Engineering Societies' committee on elimination of waste in industry will be completed by April 15, according to a statement this week by Secretary L. W. Wallace, when the publication of the final report of the committee will be undertaken immediately. It is anticipated that the final report will be published some time in June. The findings of the committee, Mr. Wallace states, thus far are very significant, and there is every reason to believe that the publication of this report will create a great deal of interest.

The next meeting of the executive board is to be held in Philadelphia on April 16 at the Engineers' Club. A dinner at the Bellevue-Stratford is scheduled for the evening of April 16, which is to be addressed by the president, Herbert Hoover. It is expected that this will be one of the most important meetings that the board has ever held.

Electrical Home Arouses Interest in Chicago

MORE interest was created by the electrical home built for display at the Chicago "Own-Your-Home Exposition," according to the management, than by any other single exhibit. The exposition was open to the public from March 28 to April 2 inclusive, and during those six days it is estimated that more than 30,000 persons inspected the home and its furnishings. The home was sponsored by the Electrical Contractors' Association of Chicago, and electric appliances and furnishings were supplied by the Commonwealth Edison Company, Western Electric Company, Electric Appliance Company, American Electric Supply Company, Metropolitan Electric Company, Illinois Electric Company, Inland Electric Company and Marshall Field & Company.

The home consisted of living room, dining room, kitchen, two bedrooms and bath and was built from the prize-winning design in the architects' national small-house competition. The living room and dining room were lighted by wall brackets and floor lamps, with numerous wall outlets for the floor lamps and for toasters, percolators and other appliances. The kitchen was furnished with electric dishwasher, ironer, washing machine, refrigerator, vacuum cleaner, cooker, exhaust fan and intercommunicating telephone. In the bedrooms were found ceiling lights, several conveniently arranged wall brackets, wall outlets for appliances and bed lamps and intercommunicating telephones. It is understood that, encouraged by the impression made on the public by this temporary exhibit, various Chicago electrical interests are considering the construction of a permanent electrical home.

In addition to this exhibit a lighting exhibit was arranged by the Chicago Lighting Fixture Council and by C. G. Everson & Company, Chicago. It was attempted by means of these exhibits to educate the public to buy fixtures on a style and not a price basis. Other exhibits were arranged by manufacturers of electric household appliances.

Vermont Association Elects Officers

AT THE annual meeting of the Vermont Electrical Association held in Burlington recently the following officers were elected for the ensuing year: President, J. A. Prouty, Newport; vice-presidents, I. M. Frost, Rutland, and R. P. Osgood, Windsor; secretary-treasurer, C. E. Warsaw, Burlington; executive committee, Wilfred Smith of Woodstock, F. S. Nicholson of Rutland, D. W. Jardine of Burlington, C. J. Cookson of Montpelier, C. C. Wells of Middlebury and E. E. Gage of St. Johnsbury.

California Legislative Investigators Back Up Commission

FRANKLY admitting that some preconceived ideas entertained by them had undergone a complete change as the result of their investigation into the workings of the California Railroad Commission, the members of the joint legislative committee appointed to hold hearings in this matter have recommended to the Legislature of California that the public utilities act be strengthened rather than weakened, to the end that the commission shall continue to be a buffer between the people and the utilities and that capital shall be encouraged to seek investment in the development of the state's resources. The committee indorses the abrogation of contracts where this is necessary to prevent discrimination and insure a fair return; declares that in the absence of public ownership of utilities—which it neither indorses nor opposes—regulated monopoly is the only solution of the problem of public service, competition being neither necessary nor desirable; opposes granting to municipalities the right to withdraw from the commission's jurisdiction; sanctions the raising of rates to meet increased cost of operation, but suggests that a fixed term might be set during which a further increase should not be sought; denies that the commission has based rates on the "cost plus" theory or allowed dividends on watered stock; makes recommendations regarding certain promotion abuses which the commission has no power to prevent; finds that on the whole the work of the commission has been performed without avoidable delays or postponements, and urges that this work be brought closer to the people by having a representative of the commission in each community, which could be done by consolidating with the commission the State Department of Weights and Measures.

Increased appropriations to enable the commission to see that the consumers are amply represented at its hearings are suggested by the investigating committee

to the Legislature. It also recommends a standard form of contract for service, the use of which should be compulsory upon the utilities and which should contain a provision in plain type showing that the rates therein set forth are subject to change by the commission at any time, anything in the contract to the contrary notwithstanding. Another recommendation is that all literature relating to the sale and advertising of the securities of any public service corporation be supervised by the commission and that nothing in that literature be permitted which can be construed by the public as an indorsement of such securities or of the rate of the return thereon by the commission. The committee also holds that the commission should more strictly enforce the penalties provided by the public utilities act for violations of the act and of the rules and regulations of the commission, more particularly with regard to overcharges for extensions and service.

Co-operative Instruction in Industrial Heating Planned

UNDER the auspices of the power sales committee of the New England Division of the National Electric Light Association, it is expected that experts from the factories and sales offices of the Westinghouse Electric & Manufacturing Company, Cutler-Hammer Manufacturing Company and General Electric Company will participate in giving a three days' industrial-heating lecture course at Boston during the week beginning May 8. It is planned to set forth the history, development and applications of modern industrial electric heating apparatus by illustrated talks designed to appeal to central-station power engineers, industrial-plant engineers and executives and others interested in concentrated and efficient applications of controlled heat. A large attendance is looked for.

Minneapolis Street Lighting Under Fire

THAT the street-lighting system of Minneapolis fails in efficiency and causes a strain on the eyesight of its citizens is the reported conclusion of a committee of the Civic and Commerce Association of that city. The five-light cluster standards on the ornamental system installed less than five years ago are admitted to fall short of the standards of good illuminating engineering, and there is room also for improvement in the magnetite system.

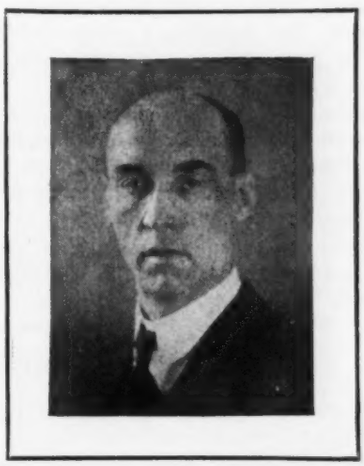
A committee of the association having the co-operation of the Engineers' Club made the report. It is asserted that the cost per mile per year for arc-lighted streets is $374, for ornamental lights $2,407 and for gas lights $1,073. Two ideas have developed from the discussion, one being to throw away every part of the present ornamental system and start afresh. The cost of this plan is estimated at $3,000,000 to $4,000,000, which would necessarily be covered by a bond issue. The other idea contemplates the changing of the present equipment in the ornamental standards so as to direct the light rays toward the street and kill the glare. This, it is asserted, can be done at a nominal cost per standard.

Rerouting of car lines in the downtown districts has created a demand for extensions of the ornamental system, and some single-light 500-watt units are about to be installed. No final plans have yet been made.

Department of Commerce to Have Closer Relations with Business

ANNOUNCEMENT was made on Monday of this week by the Chamber of Commerce of the United States of the appointment of a committee of five, with five alternates, to co-operate with Secretary Hoover in working out a plan for closer relationship between business and the Department of Commerce. The committee, which was named at Mr. Hoover's request, met with the Secretary on Tuesday. Members of the committee are: A. C. Bedford, New York, chairman of the board of directors of the Standard Oil Company of New Jersey; George E. Smith, New York, president of the Royal Typewriter Company; John H. Fahey, Boston, publisher; Homer L. Ferguson, Newport News, Va., president of the Newport News Shipbuilding & Drydock Company; Philip H. Gadsden, Philadelphia, president of the American Electric Railway Association. The five alternates are: Lewis B. Stillwell, New York, electrical and consulting engineer; Howard Elliott, New York, chairman Northern Pacific Railway Company; R. Goodwyn Rhett, Charleston, S. C., president People's National Bank; Henry M. Victor, Charlotte, N. C., cotton manufacturer and president Union National Bank; A. L. Humphrey, Pittsburgh, president Westinghouse Air Brake Company.

To Confer on International Standardization



Dr. P. G. Agnew, secretary of the American Engineering Standards Committee, sails for England on April 12 to attend a conference of secretaries of national standardizing bodies to be held in London this month.

Wasteful Competition Between Utilities Now Barred in Washington State

HENCEFORTH before any public utility company in the State of Washington can enter the field in competition with an established utility it must first appear before the Public Service Commission of the state and show the necessity for the duplication of service. This has been made law through the passage by the Legislature of the "act to prevent waste in duplication of public utilities" recommended to the Governor by the commission. The bill had a large majority. It applies also to proposed municipal plants.

A. I. E. E. to Award Prizes for Original Papers by Members

ONE hundred dollars in cash and a suitable certificate are to be offered by the American Institute of Electrical Engineers every year for the most worthy original paper presented during the year at a meeting of any section of the Institute by a member who has never before presented a paper at an Institute or section meeting. Two similar prizes—one for enrolled students of the A. I. E. E. and the other open to all members—have been approved by the directors for future award, but will not be offered this year.

The board has also accepted an offer from the Jeffery-Dewitt Company to donate to the Institute each year a prize of $100 for the best paper on a subject within the field of high-tension transmission and distribution. The details have not yet been announced, but it is understood that all papers presented before the Institute during the calendar year 1921 within the field of high-tension transmission and distribution are eligible for this award. The procedure to be followed in connection with the award of both the prizes will be announced later.

Inter-Scandinavian Power Exchange Planned

SOME very definite plans are now receiving consideration for an inter-Scandinavian power exchange. This, according to the ELECTRICAL WORLD'S correspondent in Sweden, is to be based on a power agreement between Sweden, Norway and Denmark on an official basis. Already the Swedish Foreign Office has been approached by Norway, but when this was written no reply had been given.

For some time Norwegian engineers, realizing that Norway has about ten times as much water power as Norwegian industry will be able to use in the next hundred years, have been considering the possibility of exporting power to Denmark. The line, as it was first proposed, would run through Sweden and in cable under the sound and would cost around 90,000,000 kronen ($20,000,000).

The latest idea, however, is to join the Norwegian power system to the Trollhättan system in Sweden and run a line south to the private power system in southern Sweden, and thence into Denmark.

From 100,000 kw. to 200,000 kw. is involved at a transmission pressure of either 100,000 volts or 200,000 volts.

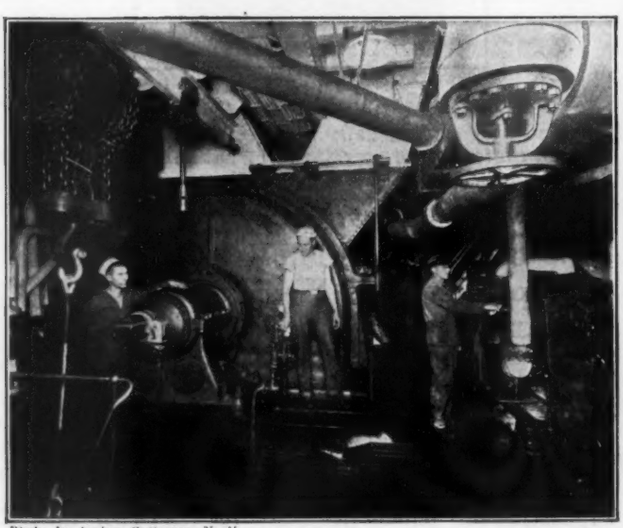
Prize Essay Contest on Courtesy and Good Will at Boston

PRESIDENT C. L. EDGAR of the Edison Electric Illuminating Company of Boston has authorized a prize essay contest among employees upon one or more phases of the "courtesy and good-will" campaign which has been running in the company for more than a year past. The company now has about 2,000 employees, and the award will be announced at the annual field day, June 25. The following board of judges has been named: Chairman, L. D. Gibbs, superintendent of advertising Boston Edison company; W. E. Holmes, general manager Cambridge Electric Light Company; F. J. Whiting, editor *Stone & Webster Journal;* H. W. Moses, superintendent employment bureau, Boston Edison company; H. S. Knowlton, New England editor ELECTRICAL WORLD.

New York Electrical Show to Be Held in Armory Sept. 28 to Oct. 8

THE Grand Central Palace, in which previous exhibitions have been held, being no longer available for exposition purposes, the management of the New York Electrical Exposition has selected the Seventy-first Regiment Armory, Park Avenue and Thirty-fourth Street, New York, as the place for the 1921 show, which will begin Sept. 28 and last ten days. The armory is said to combine suitable floor arrangements, facilities for handling the exhibits and accommodations for spectators. As in former years, the 1921 show will feature electrical equipment for the home, motor-driven machinery for industrial purposes, electrically operated material-handling machinery and electric vehicles.

Electrical Equipment on Newest Superdreadnought



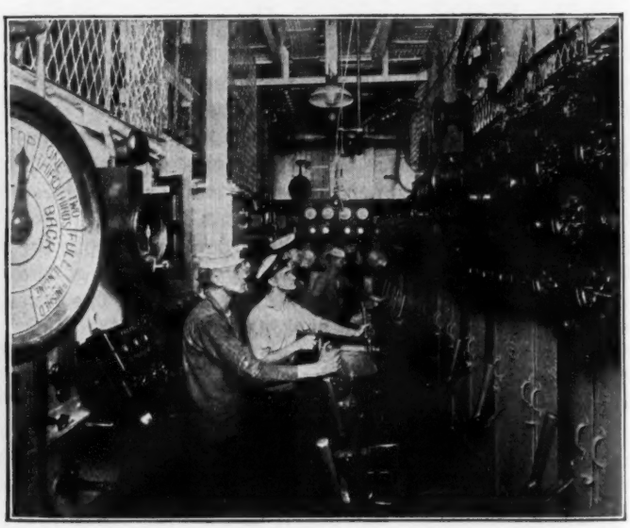


Photo by Ewing Galloway, N. Y.

At the left is shown one of the 20,000 hp. Westinghouse generators of the U. S. S. *Tennessee*, the newest of Uncle Sam's superdreadnoughts. The entire control of the ship is centered in the room shown at the right.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Municipal Electric Plant Voted Down at Ogden. — An election was held at Ogden, Utah, on March 26 to determine, among other things, whether bonds for $500,000 should be issued to establish a municipal electric plant. This proposal was defeated by a close vote.

Another British Tidal-Power Scheme. —A report is now being prepared in Great Britain on a scheme to utilize the tides at Walney Island to supply electrical energy to the Barrow district of Lancashire, with its great industrial development. As with the similar project for the River Severn, even if all engineering difficulties were overcome, the cost of the enterprise would, conservative authorities think, be likely to prove prohibitive.

Hydro-Electrification in Spain.—Contracts have been signed for the use of hydro-electric motive power on an inclined section of the Norte railroad of Spain, this section lying between Gijón and León. It is thought that a proposed steam central station for use in this work can be dispensed with or at least simplified and used only as a reserve, there being enough power available from hydro-electric companies operating in the neighborhood to take care of normal operation on the grade.

Tax on Power Development in Ontario.—The Premier of Ontario has said publicly that there will probably be a tax on the development of hydro-electric power in that province, but he has given definite assurance to the secretary of the Ontario Municipal Electric Association that the tax will not be so much as the $2 per horsepower that was recommended by the special committee of the Legislature which recently reported on the subject. The Premier assured the assocation that the government does not intend to take any drastic action.

Exposition to Show Electrical Advertising Methods. — Plans are rapidly taking shape for an electrical advertising display which the New York Edison Company is to hold in its Irving Place showroom during the week of May 2-9. Many manufacturers of signs have accepted an invitation to take part. Roof signs will be shown with their flashers in actual operation; store-front signs will make up another part of the exhibit, and a third department will include the so-called directional signs. An effort is being made to have an exhibit of early sign material, and Major William J. Hammer, who as Edison's representative in London in 1881 built the first electric sign, has been invited to contribute material from his historical collection. As 1921 is the fortieth anniversary of the making of the first sign, it is thought a historic exhibit of this nature will be of great interest.

Hydro-Electricity in Western France. —The first important hydro-electric installation in the west of France is being pushed to completion on the River Vienne, where three falls, at Isle-Jourdain, Joussaud and Chardes, have made feasible the construction of power houses rated at 9,000 hp., 9,000 hp. and 5,000 hp. respectively. The first of these power houses, built upon the dam itself, is about ready and contains three Francis turbines each coupled to a three-phase alternator, with room for a fourth group. Energy generated at 5,000 volts and 50 cycles is to be raised to 60,000 volts for transmission. Work on the Chardes development also has begun. The combined installation will serve a rich agricultural region.

"Bell Loud Speaker" Carries Inaugural Address to Vast Crowd. — By means of the "Bell loud speaker" President Harding's voice was so amplified that it is estimated that quarter of a million persons heard him deliver his inaugural address at Washington on March 4. This was the first public exhibition of the perfected device, which has required years of research to develop and which, the Bell engineers say, will make it possible for the human voice to reach a million hearers clearly when no buildings on any side block its path. The crowd at the inauguration saw no equipment, the great horns being concealed in the roof of the rostrum erected for the President's use and the electrical apparatus being beneath this stand and under the portico. The system consisted essentially of three parts —a specially constructed, ultra-sensitive transmitter, shielded with copper to carry off interfering currents however minute, placed directly in front of the speaker; a series of vacuum-tube amplifiers in a control room, these providing eight stages of amplification for the current from the transmitter, and the loud-speaking telephone receivers attached to the large wooden horns already referred to. The apparatus was provided without cost to the government by the Chesapeake & Potomac Telephone Company, of which A. E. Berry is president.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Electric Club of Chicago.—On Tuesday of this week L. E. Myers addressed this club on "Electricity in Its Infancy and the Problem of Today." Next Tuesday, April 12, is to be ladies' day.

Detroit Engineering Society.—C. F. Hirshfeld, chief of the Detroit Edison Company's research department, will speak before the Detroit Engineering Society on Thursday evening, April 14, his topic being "Industrial Electrical Heating."

Providence Section, A. S. M. E. — "The Effect of the Variable-Speed Motor on Heat Balance in Finishing Plants" will be discussed by Warren B. Lewis, president of the Providence (R. I.) Engineering Society, before the Textile Section of the A. S. M. E., meeting with the Providence Section on Tuesday next, April 12.

Electric Club Organized at Los Angeles.—Representative officials from every branch of the electrical industry met at Los Angeles recently and formed the Electric Club, with these officers: President, H. L. Harper, district manager Western Electric Company; first vice-president, A. W. Childs, sales manager Southern California Edison Company; second vice-president, J. C. Rendler, president Southern California Electric Company; third vice-president, N. R. Powley, commercial superintendent Southern California Telephone Company; secretary-treasurer, F. J. Airey, manager Pacific States Electric Company; executive secretary, E. F. Moss; sergeant-at-arms, J. G. Pomeroy. The club's objects are the promotion of hydro-electric development in southern California and the general use of electrical energy. Carl M. Heintz, advertising manager of the Westinghouse Electric & Manufacturing Company, is chairman of the publicity committee.

Coming Meetings of Electrical and Other Technical Societies

A. I. and S. E. E. Section Meetings—Cleveland Section, April 11; Pittsburgh Section, April 16.

Pennsylvania Electric Association, Western Section—Pittsburgh, April 15.

A. I. E. E. Section Meetings—Pittsburgh (joint session with A. I. and S. E. E.; for program see issue of March 19, page 672), April 16; New York (joint session with A. S. M. E.), April 22; New York, May 20.

American Welding Society — Metropolitan Section, New York, April 19.

Missouri Association of Public Utilities — Kansas City, April 21-23.

American Electrochemical Society—Atlantic City, April 21-23.

American Physical Society — Washington, April 23.

United States Chamber of Commerce — Atlantic City, April 27-29.

American Society of Civil Engineers — Houston, Tex., April 27.

American Association of Engineers—Buffalo, May 9-11.

American Washing Machine Manufacturers' Association—Chicago, May 18-19.

N. E. L. A., Southwestern Geographic Division—Hot Springs, Ark., May 13-14.

Southwestern Electrical and Gas Association—Galveston, Tex., May 18-21.

National Electric Credit Association—Richmond, Va., May 19-20.

American Society of Mechanical Engineers —Chicago, May 23-26.

Electrical Supply Jobbers' Association—Hot Springs, Va., May 25-27.

N. E. L. A.—Annual convention, Chicago, May 31-June 3.

N. E. L. A., Pacific Coast Section — Del Monte, Cal., June 7-9. (For program see issue of Jan. 29, page 278.)

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

The Coal "Rider" and the Minimum Charge.—The State Corporation of Virginia has ruled that the Virginia Railway & Power Company cannot add the surcharge for fuel to its minimum charge. When the energy charge plus the coal charge is less than the minimum charge the bill must be for the minimum amount only.

Income Tax Must Not Be Charged to Operating Expenses.—The federal income-tax law, declares the District of Columbia Public Utilities Commission, thus ranging itself with various state commissions which have made the same pronouncement, contemplates that the burden shall be imposed on the corporations and paid out of their net profits and not passed on to the public, and this tax is, therefore, not a proper charge to operating expenses.

Deficit in Water Department Must Not Be Recouped by Increase in Electric Rates.—The Wisconsin Railroad Commission has granted to the Richland Center municipal electric and water plant an increase in its water rates but has refused an increase in electric rates, finding the latter adequate under the present schedules and declaring that no adequate reason exists why a loss on fire protection and unmetered water service should be met by the users of electrical energy.

Reasonable Return from Extensions an Essential Element.—A complaint asking that the Duquesne Light Company be required to extend its lines to furnish electric light to complainants was dismissed by the Public Service Commission of Pennsylvania, where it appeared that the territory to be served was sparsely settled and offered no prospects for development in the near future and where the return on the necessary investment over and above the cost of producing the energy and maintaining the service would amount to little more than 2 per cent.

Distributing Company Cannot Shift Responsibility for Poor Service to Selling Company.—An electrical company purchasing energy from another company will be held responsible for inadequate service and cannot excuse itself on the plea of poor service rendered to it by the selling company. So holding, the Illinois Public Utilities Commission allowed to the McHenry County Light & Power Company a return of only 6 per cent upon the rate base until such time as it shall maintain service in accordance with the standards of the commission. In the case at issue the Illinois company purchased its supply of energy from the Southern Wisconsin Electric Company, which in turn purchased from the Wisconsin Gas & Electric Company, the selling companies being in another state and beyond the jurisdiction of the Illinois commission.

Period of Repose—Filing of Schedule.—Within the time designated by a commission order, the New York Public Service Commission for the Second District has found, the statute provides that the prices fixed shall be the minimum to be charged for a period to be fixed by the commission not exceeding three years and there can be no further increase in utility rates by way of a service charge or otherwise. A utility company must, the commission held in the same case, instead of filing a tariff, apply to the commission for permission to increase rates filed by order of the commission.

Company Cannot Advance Rates by Merely Filing Tariff with Commission.—Although applying to the Public Service Commission of New York, Second District, for an order granting increased electric rates, the Rockland Light & Power Company maintained that under the law approval of its schedules by the commission was not obligatory except where the rates previously in force had been found unjust, and further maintained that it had the right to charge the new rates after the filing of its tariff. The commission approved the tariff as filed, but denied the company's contention just stated, asserting that, although the period of the commission's last previous order had expired, that order remained in effect until the commission should issue a new order to take its place. A concurrent petition from the company for permission to increase its gas rates by adding a service charge to a fixed maximum charge was denied on the ground that the term of the commission's last previous order had not expired.

Refusal of Service Not Justified in "Saturated" Community. — The Idaho Power Company objecting to extend service in cases where the investment cost would exceed the probable return for one year unless the difference between investment cost and yearly return were advanced by the applicant, the Public Utilities Commission of Idaho overruled the contention, asserting: "With this contention the commission cannot agree. This service is required in the city of Caldwell, which for many years has been served by this utility and where a fair state of saturation of service has been reached. It is reasonable to assume that in this city there are many individual services where the disparity between investment and return would equal or exceed the one under discussion, and also many individual services where the amount of revenue will equal if not exceed the cost of extension required to furnish, and to draw the line as proposed by the power company in the instant case would appear to the commission to be an attempt to collect the cream and reject the milk."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Attempt to Cut Fallen Electric Wires Where No Emergency Existed Act of Intermeddler.—A man somewhat familiar with electricity who discovered near his home the fallen wires of a power company, from which flames were issuing, and who first kicked them apart and afterward was injured in attempting to cut them in two, was an intermeddler and could not recover damages. This was the finding of the Supreme Court of New Hampshire in Croteau vs. Twin State Gas & Electric Company. The plaintiff maintained that he was actuated by fear that his children might meet injury from the fallen wires, but the court held that no emergency justifying the risk he assumed existed. (112 At. 397.)*

Damages Recovered Because of Fright Caused by Meter Reader Entering Without Knocking.—In Mollman vs. Union Electric Light & Power Company the plaintiff, a nervous woman, recovered judgment in the sum of $500 because of severe fright and subsequent illness alleged to have been caused by defendant's meter reader entering her house without knocking or otherwise making his arrival known in advance. The electric company appealed, maintaining that its contract with plaintiff's husband gave its meter reader the right to enter the premises in performance of his duty at seasonable hours. The St. Louis Court of Appeals sustained the verdict found in the lower court, holding that the manner of entrance was an invasion of the sanctity of the home. (227 S. W. 264.)

Oklahoma Corporation Commission Restrained.—In granting a writ prohibiting certain acts on the part of the Corporation Commission of Oklahoma, on the petition of Oklahoma City, the Supreme Court of the state held that the commission had no authority to require consumers of gas to pay an additional rate for the benefit of a public service corporation furnishing gas to the local company owning a franchise, the said supplying corporation receiving as remuneration a certain percentage of what the local company collects. Nor had the commission authority to make an order requiring the consumers of gas to pay a sum over and above a fixed rate for the purpose of creating a special fund which might be used in the future by the corporation with the commission's consent to build additional lines and compressor stations. (195 Pac. 498.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Men of the Industry

Changes in Personnel—Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

Dr. Ernest Fox Nichols, past-president of Dartmouth College and for the past year director of physical science at the Nela Park Research Laboratory of the National Electric Lamp Association, Cleveland, has been elected president of the Massachusetts Institute of Technology. He succeeds the late Dr. Richard C. Maclaurin. In the interim following the death of Dr. Maclaurin in January, 1920, Dr. Elihu Thomson of Swampscott, Mass., has served as acting president of the institute. Dr. Nichols has attained a brilliant reputation in the field of physics, and his broad experience as an educator and as a scientist is counted upon to give the institute an administration ranking with those of his distinguished predecessors. He was born at Leavenworth, Kan., June 1, 1869, and received the B.Sc. degree from the Kansas Agricultural College in 1888, M.Sc. from Cornell University in 1893 and Sc.D. from Cornell in 1897. From 1889 to 1892 he was a graduate student in physics at Cornell and from 1894-96 at the University of Berlin. He studied at Cambridge University in 1904-05. In 1903 he received the honorary degree of Sc.D. from Dartmouth College and later LL.D. degrees from Colgate, Clark, Wesleyan, Vermont, Pittsburgh and Denison universities and Dartmouth College. Dr. Nichols' early career includes professorial work in physics at Colgate University, Dartmouth College and Columbia University. From 1909 to 1916 he was president of Dartmouth College and from 1916 to 1920 professor of physics at Yale University. From 1907 to 1909 he served as research associate at the Carnegie Institution, Washington, D. C., and from 1917 to 1919 was attached to the Bureau of Ordnance, U. S. N. In 1905 he received the Rumford Medal of the American Academy of Arts and Sciences. He is a member of the National Academy of Sciences, American Philosophical Society, American Physical Society, American Astronomical Society and Washington Academy of Sciences and a fellow of the American Academy of Arts and Sciences and of the American Association for the Advancement of Science. He is a collaborator of the *Astrophysical Journal* and has contributed many papers to scientific journals in this country and abroad on radiation and other subjects. While working for the Bureau of Naval Ordnance during the war he developed certain valuable optical devices whose character has never been disclosed by the government. As a student in the physical laboratory of the University of Berlin he discovered the metallic reflection of quartz and its anomalous dispersion in the infra-red spectrum, which led at once to a new method of spectrum analysis by which the knowledge of the spectrum was increased to six times the previous limits.

E. F. NICHOLS

C. S. Ruffner, who has been associated in an executive engineering capacity with subsidiaries of the North American Company since 1911 and up to the present time has been vice-president and director of that company with headquarters in New York City, has resigned to become vice-president and general manager of the Adirondack Power & Light Corporation. Mr. Ruffner took up his new duties on April 1. The company with which Mr. Ruffner goes is an important factor in the development of the Mohawk and Hudson Valley sections of New York State. Mr. Ruffner's career as an engineer and executive was outlined in the ELECTRICAL WORLD for Feb. 19, 1921, page 447.

C. S. RUFFNER

P. S. Minner, the new district manager of the Southern California Edison Company at San Pedro, who was recently promoted from the Redlands district as announced in the ELECTRICAL WORLD, has a record of thirty years' experience in the electrical industry, having been connected with this business continuously since 1891. Following twelve years in the construction department of the Chicago Edison Company he took an active part in the organization and management of the Central Electric Company at Omaha, Neb. Because of ill health he moved to California and in 1912 entered the commercial department of the Southern California Edison Company, where he has successfully filled various positions in the district organization. In 1919 he was appointed assistant district manager at Redlands, a position he held up to the first of this year.

P. S. MINNER

Guido Semenza, a consulting engineer of Milan, Italy, who is the honorary secretary of the American Institute of Electrical Engineers in that country, will arrive in the United States on April 21 on a visit.

N. S. Franklin, superintendent of the New Britain district of the Connecticut Light & Power Company, Waterbury, Conn., has resigned. Albert S. Jourdan, formerly superintendent of the Waterbury district of the company, succeeds him in that capacity.

A. Becsey, chairman of the mechanical and electrical engineering section of the Hungarian Institute of Architects and Engineers of Budapest, is visiting this country for the purpose of reestablishing the friendly intercourse between Hungarian and American technical societies which formerly existed and was terminated by the great war. Mr. Becsey is making his headquarters at the Swedish Legation in Washington.

A. S. Gjolme, government engineer of Christiania, Norway, is making a tour of hydro-electric developments in this country for the purpose of studying the behavior of tunnels under pressure. Three Norwegian hydro-electric plants possessing tunnels operating under heavy pressures have developed leakage troubles.

Don N. Finlayson, who has recently succeeded W. J. Tideman as factory manager of the Tideman Electric Manufacturing Company, Cairo, Ill., was formerly general manager of the Detroit Pneumatic Chuck Company.

D. N. FINLAYSON

Prior to that he was associated with the Dodge Brothers Company of Detroit as efficiency engineer. During the war Mr. Finlayson was connected in an executive capacity with the United States Army's bureau of air-craft production. For more than twenty years he has served in responsible capacities in efficiency and production work.

James E. Watson, formerly sales manager of the Elliott Company, Jeannette, Pa., manufacturer of power accessories, has been appointed general manager of that company. C. L. Brown succeeds Mr. Watson as sales manager.

D. H. Kelly has been appointed vice-president and assistant general manager of the U. S. Light & Heat Corporation, Niagara Falls, N. Y., to succeed C. L. Lane, who has resigned as vice-president and general manager of the company. For the past two years Mr. Kelly has been assistant sales manager of the Willys light division of the Electric Auto-Lite Corporation.

Frederick G. Simpson, formerly chief engineer and general manager of the Kilbourne & Clark Manufacturing Company and Ship Owner's Radio Service, Inc., Seattle, Wash., has established offices in the L. C. Smith Building, Seattle. He is prepared to undertake the design and to supervise the construction of electric plants, machinery and instruments, including lighting, power and communication systems.

R. F. Harrison, Cleveland representative of the Cleveland Electric Motor Company, has been transferred to Chicago as district manager, with headquarters at 1242 Monadnock Building.

T. F. Crawford, formerly St. Louis district sales manager of the Elliott Company, Jeannette, Pa., manufacturer of power accessories, has been transferred to the Philadelphia office in the same capacity.

E. N. Lightfoot has been appointed manager of the heating department of the New York works of the Cutler-Hammer Manufacturing Company, Milwaukee.

L. W. Hench has been appointed secretary and general manager of the International Oxygen Company, Newark, N. J., succeeding Eugene Schoen, who has resigned.

T. G. Whaling, general manager of the Westinghouse Lamp Company, accompanied by R. W. Murphy, Pacific Coast manager of the Westinghouse Lamp Company, is making an extended business trip through the Western States.

L. B. Timmerman has been placed in charge of the Cleveland office of the Cutler-Hammer Manufacturing Company, Milwaukee, to act in the capacity of assistant to A. G. Pierce, manager of the central district

G. S. Crane, formerly manager of the Cleveland office of the Cutler-Hammer Manufacturing Company, Milwaukee, has been appointed manager of controller sales at the main office in Milwaukee.

Stuart Bartram, formerly electric range specialist for the Edison Electric Appliance Company, Chicago, has been appointed general sales manager for the H. G. Weeks Manufacturing Company, Hamilton, Ohio, manufacturers of electric ranges and sterilizers.

M. F. P. Green has recently been appointed Southern sales manager of the Arrow Electric Company, Hartford, Conn., manufacturer of electric wiring devices. His headquarters will be at 804 Continental Building, Baltimore. Mr. Green will have charge of sales in all the South Atlantic States.

George J. Blanton, who for the past four years has been connected with the engineering sales department of the Chain Belt Company, Milwaukee, has been made New York district manager at 50 Church Street, New York City. Previous to 1917, Mr. Blanton was associated with the General Electric Company for eight years, three years of which were spent in Schenectady, N. Y., and the other five in the Milwaukee office. Since Mr. Blanton has been with the Chain Belt Company he has been prominently connected with the largest installation of traveling water screens yet on record as well as with various conveying installations all over the country. Mr. Blanton is a graduate of the University of Michigan department of mechanical and electrical engineering, class of 1909.

Robert C. Weller has been appointed general sales manager of the Lakewood Engineering Company, Cleveland.

Wallace B. Conant, proprietor of the Conant Machine Company, Concord Junction, Mass., manufacturer of power-driven loading equipment, has been elected chairman of the Concord municipal lighting board.

Gilbert E. Ryder has been appointed vice-president in charge of sales for the Locomotive Superheater Company, manufacturer of superheaters and boilers, with offices in New York. Mr.

G. E. RYDER

Ryder entered the employ of the Locomotive Superheater Company ten years ago as a member of the service department and later took charge of that department, which today is responsible for the operation of 30,000 superheaters on locomotives in this country. He also developed and had charge of the publicity department. Mr. Ryder was deputy smoke inspector for the city of Chicago in charge of locomotives.

Obituary

Willis H. Trenner, chief engineer and superintendent of power for the Idaho Power Company, Boise, Idaho, died in New York City on March 6 from pneumonia. He had been in New York since January on business for the company. Mr. Trenner was born in Glenwood, Wash., June 4, 1879, and was graduated from the Washington State College in 1903. He went to Idaho in 1908 to install an electric power plant at the De Lamar mines at Silver City, and in March of that year he was appointed general superintendent of the Idaho-Oregon Light & Power Company, holding the same position with the Idaho Railway, Light & Power Company until 1914. When the Idaho Power Company was formed in 1915 Mr. Trenner was made chief engineer and superintendent of power, a position he had held ever since.

Trade and Market Conditions

Business Reviews, Together with Market Letters from Important Trade Centers, on the Supply, Demand and Prevailing Prices of Electrical Apparatus and Supplies

Refractories Production Low with Light Steel Trade

WITH the general dependence of refractories manufacturers on the steel trade, it is no wonder that expressions of opinion from about forty-seven different manufacturers, represented at their annual meeting in New York on March 16 to 18, showed that business was dull and could hardly be expected to pick up to any great extent till fall by the earliest and possibly not before next spring. There were only two or three good business reports.

These manufacturers generally establish their plants near coal mines, to be near their source of fuel supply, and near steel mills, to be near their principal market. Consequently their wage scales are regulated largely by the wage scales paid by those two industries. Still, this year there have been two wage cuts, each following a price cut of about 10 per cent in the refractories industry. Further reductions in steel prices and wages, it is thought, would immediately result in general business activity on an increasing scale.

The electric furnace industry has called for materials of a higher refractory power than were previously used because of the greater heat generated. This business is continually growing, so the refractories companies have been expanding their services in this direction. There is no delay experienced in making shipments on any kind of order.

Improvement Shown in Market for Electric Ranges

SALES of electric ranges have started to show their usual spring increase, according to a survey of manufacturers in this field. The volume of business as yet is not large, but an increasing number of inquiries and the general slight improvement in orders that has been noted lends a basis for optimism that the year's business will be good.

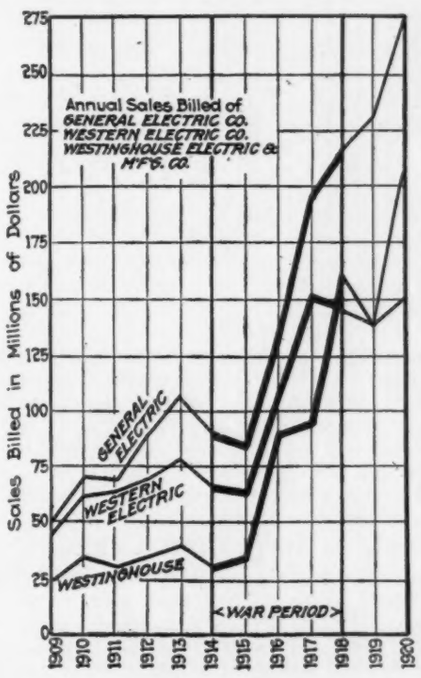
In the East manufacturers report a noticeable increase in demand within the past month. On the Pacific Coast business has been recently stimulated by price reductions, while in the Intermountain section of the West and also in Chicago territory prospects for good sales are seen and jobbers and central stations are stocking. In the South and in St. Louis territory, however, trade in this line has remained extremely dull.

An increasingly important aspect of the range market, it is reported, has been the demand for heavy-duty equipment used by hotels, bakeries, restaurants, etc. For one thing this load is generally favored by power companies because the installation is most often in a downtown city district where line equipment facilities are adequate, and the current load of this type of range is pretty evenly distributed over the day and night. Because the converse of these conditions is often true of domestic range installations, many central stations unfortunately are not inviting this class of business. As a result, not enough attention has been devoted to the question of special cooking rates, and in many communities such as New York City the prohibitive cost of operation materially holds down sales.

Reports from different parts of the country indicate that consumers have considered range prices too high, and even in those instances where price reductions have been made reluctance is very often displayed to make an investment such as the first cost represents. Some manufacturers since the first of the year have reduced prices 10 per cent and even more while others as yet have not lowered prices. In some of these latter cases stocks of high-priced material have been held, but despite this reductions will ultimately be made, it is expected. In line with the general declining market producers are not stocking heavily, but surplus supplies both at factory and with distributers are sufficient to insure immediate shipments for the present.

Three Producers' 1920 Sales Total $632,000,000

BILLINGS for the calendar year 1920 of the three largest electrical manufacturers again show an upward trend and the total amount reaches approximately $632,000,000. The reports of the General Electric Company and of the Western Electric Company have been made public, while the figures used for the Westinghouse Electric & Manufacturing Company are the result of an estimate, as the fiscal year of that company closes March 31. Sales billed of the Western and Westinghouse companies declined in 1919, but they are again on the up grade. The previous year's billings were about $500,000,000.



SECOND POST-WAR YEAR SEES SALES TENDING UPWARD AGAIN

Bookings of all the companies were at a high rate over the first half of 1920, much higher than the final figures show. At one time General Electric was receiving orders at a rate of a million dollars a day. But in the latter half of the year these orders receded to a great extent for all the companies. During the three months of this year General Electric's bookings have been running around $4,000,000 a week, or about $17,000,000 a month. Westinghouse has been receiving orders at the rate of about $7,300,000 a month for these three months.

At the end of December, 1920, unfilled orders on the books of General Electric amounted to $111,800,000; Western Electric had $83,000,000 unfilled. An estimate of Westinghouse unfilled orders at that time is $79,500,000.

From present indications it hardly seems possible that 1921 buying will resume in time on a buying basis sufficient to exceed the figures of 1920. The greatest drawback is stated to be the cost of money. Public utilities all over the States have extensive plans already drawn to push out their lines into new territory, to increase present capacity and to build entirely new stations. Foreign exchange depreciation is holding back much needed development in other countries. Although electrical apparatus of any class costs less today than it did last year, still money costs so much

that the utilities cannot afford to borrow it. At the same time the electrical manufacturing field never presented such possibilities for continued large business as at present.

February Exports Show Total of $13,632,478

ALTHOUGH the total electrical exports for the month of February, 1921, are nearly $2,000,000 less than those for January, they are nevertheless higher than any other month previously on record except those of last December. Last October the exports really took a decided jump of more than two millions and in November went over the ten-million mark; December was over thirteen millions, January, 1921, was over fifteen millions, and now February keeps up the record with $13,632,478.

Total exports to date this year amount to $28,965,433. The first four months of last year were just under this figure. The entire year 1913 was the first to approach this figure,

	February 1920	February 1921	Two Months Ended February 1920	Two Months Ended February 1921
Batteries	$526,972	$451,756	$901,702	$1,107,468
Carbons	76,586	62,337	216,226	133,160
Dynamos and generators	363,340	774,607	776,633	1,404,068
Fans	78,756	309,373	98,343	667,817
Heating and cooking apparatus	140,020	381,742	243,839	673,288
Insulated wire and cable	567,036	1,123,873	1,228,878	3,571,527
Interior wiring supplies	195,514	377,540	364,403	799,555
Arc lamps	172	1,234	262	2,664
Carbon-filament lamps	9,746	14,804	16,879	23,879
Metal-filament lamps	363,391	597,917	575,088	1,218,351
Magnetos, spark plugs, etc.	251,876	159,513	513,418	463,413
Meters and measuring instruments	219,454	375,705	407,577	774,583
Motors	828,727	2,426,433	1,563,963	4,490,857
Rheostats and controllers	86,482	114,235	105,040	275,488
Switches and accessories	381,203	663,566	675,239	1,460,812
Telegraph apparatus	16,750	56,069	200,154	155,742
Telephones	253,457	819,802	483,643	1,479,175
Transformers	295,185	1,320,481	645,549	2,245,853
All others	1,930,537	3,601,491	3,898,689	8,017,733
Total electricl mach'y	$6,585,204	$13,632,478	$12,915,525	$28,965,433

with $28,197,363. In the two years following the exports fell off, but in 1916 they rose again, this time to $40,244,075. And now in two months the business is bringing in nearly thirty millions.

Increases for February over January are not large on individual items, but are shown for dynamos and generators, heating and cooking apparatus, carbon-filament lamps, motors and telephones. If this average keeps up for the whole year, the total for 1921 will be more than $170,000,000.

The Bureau of Foreign and Domestic Commerce is responsible for the figures in the table.

Slight Break in Insulation Prices

ALTHOUGH prices of insulating material in general have for some time been about holding their own, further reductions on a few items have been announced recently. A standard grade of friction tape was reduced in price 6 cents per pound on April 1, a drop of 15 per cent. On the same date all varnished cloths were reduced about 7 to 8 per cent by the same company. On March 28 another manufacturer lowered the price of woven cotton tape, the cut on the 1-in. width being from $1.42 to $1.10 per gross yard.

The general view expressed by representative manufacturers is that prices in this line can hardly go lower. Cotton, rubber, shellac, etc., are all at unprecedently low figures, and the general average drop on all classes of finished insulating material has amounted to at least 33⅓ per cent, according to the estimate of a well-known manufacturer. Spot cotton at New York is quoted at 11.90 cents per pound at present. Consumers however, apparently are not yet satisfied that insulation prices have hit bottom as buying remains from hand to mouth for the most part.

Electric railways are making light repairs. Repair shops are buying such material as they need, but their present requirements are small. Manufacturers of finished products such as motors have greatly curtailed production. These outlets account for a considerable number of orders that are being received, but each order is usually small in size. There is a pretty good industrial market for motor repair work, especially steel mill, at present. There is little question that the existing market is quiet and will probably remain so for some time. Distinct optimism is manifest among manufacturers, however, as the expectation of better business persists. There has been, in fact, some slight trend toward improvement already noticed in some quarters in the number of inquiries received this month.

Stocks of finished material have been purposely kept rather low by producers, who have materially curtailed production under present market conditions. The supply is in virtually all cases quite adequate to cover present needs with immediate shipments, however.

Germans Again Undersell Electric Export Market

WORD comes from the ELECTRICAL WORLD'S correspondent in Sweden that all German business seems to be in one great muddle with no one very much concerned. Even so and with the high export fees, Germany continues to outsell everybody, thanks to the rate of exchange. The Swiss railroads, for instance, are offered Brown-Boveri electric locomotives for 1,000,000 francs apiece, while the A. E. G. offers the same thing, f.o.b. Switzerland, for 600,000 francs.

In one thing only does this correspondent find that the Germans are high, and that is insulators. One very large order for the Swedish Board of Waterfalls went to an American company at a price laid down in Sweden that was lower than the Germans could meet. A good many of the insulators of American make are seen in Europe.

The Metal Market Situation

THE copper market presents little change over a week ago, but encouragement is taken from the producer's standpoint that the recent gain in prices has been held. There is not a great deal of current buying, but now that radical cuts in production have been made to a point where it may be safely said that output is less than consumption, the market looks better. Producers are holding electrolytic for prompt shipment firmly at 12.75 cents delivered and 13 cents covering the second quarter. Foreign buying is light and may be expected to continue so in view of the coal strike in England, the Allies' advance into Germany and the recent doubling of ocean freight rates on copper affecting French Atlantic ports, Hamburg, Rotterdam and Antwerp.

The "official" price of lead, following the slight advance of last week, has again moved upward, and the market has a strong tone. Foreign competition in zinc has aided in unsettling the domestic market, which is quiet with production much curtailed. Scrap heavy lead has moved up with the parent metal but light brass is lower.

A discouraging feature to producers who have closed down their properties is the volume of copper imports which have been coming in at a rate of about 40,000,000 pounds in January and February and about 30,000,000 pounds in March.

NEW YORK METAL MARKET PRICE

	March 29, 1921	April 5, 1921
Copper	£ s d	£ s d
London, standard spot	69 12 6	68 7 0
	Cents per Pound	Cents per Pound
Prime Lake	12.75—13.00	12.75—13.00
Electrolytic	12.50—12.75	12.75
Casting	12.00	12.00
Wire base	15.00	15.00
Lead, trust price	4.10	4.25
Antimony	5.12	5.12
Nickel, ingot	41.00	41.00
Sheet zinc, f.o.b. smelter	11.00	11.00
Zinc, spot	5.15	5.15
Tin	29.25	28.75
Aluminum, 98 to 99 per cent	28.00	28.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	9.50—10.00	9.50—10.25
Brass, heavy	5.50— 5.75	5.50— 5.75
Brass, light	4.00— 4.25	3.75— 4.00
Lead, heavy	3.12— 3.62	3.50— 3.65
Zinc, old scrap	2.87½— 3.00	2.87½— 3.00

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

WITHOUT any particular spurt in business, the trend of buying seems to be always upward—slowly upward. At the same time strikes in Boston and impending lockouts in Massachusetts, the state legislative investigation into building construction at Chicago and unsatisfactory negotiations between building contractors and the unions in St. Louis all tend to hold up construction in those territories. Building is better in the South, and farmers are planting. There the municipalities and utilities are the most active. The utilities on the West Coast are also very active in the pole and cross-arm market. Collections are improving in New England.

There have been few general price changes this week, although the safety switches and knife switches of one producer are off and insulation is quoted lower. Jobber buying is light, but one New York jobber reports a return to stock buying on the basis of low price levels. Stocks are good with jobbers and manufacturers and shipments quick.

NEW YORK

The tone of trade this week is decidedly more optimistic than has been the case for some time past. Jobbers report that general sales are improving, more inquiries are received and there is more strength and volume to demand. This condition is not noticeable in the form of any decided buying spurt, however, rather in a very slowly improving market whose pulse one must continuously feel to notice the change. Several supply jobbing houses report that total sales for March went ahead of January and February.

There is still a great deal of shopping around on the part of consumers, and prices are so shaky that on many items a buyer almost makes his own price. Safety and open knife switches were reduced in price by a leading manufacturer the first of the month.

For the most part jobbers are pursuing their previous policy of not stocking material this spring but of depending upon current supplies and replenishing them from other jobbers or manufacturers as needed. One representative house at least, stating that it expects no further radical price declines, has now started to lay in a sizable stock on all standard items, varying from a two to a three months' supply.

Conduit.—The market on ½-in. block this week ranges from $63.75 to $71.50 and for 1-in. black from $131.60 to $137 per 1,000 ft. in 2,500-ft. lots, though higher prices than this are held. Demand is spotty among different houses, with good stocks.

Flexible Armored Conductor.—Sales are not heavy, but seem to be on the increase, small repair jobs accounting for a considerable number of orders. No. 14 two-wire, double-strip, in 1,000-ft. lots, is quoted from $62 to $66.

Rubber-Covered Wire.—Plentiful supplies are moving, although slowly. No. 14 single-braid brings from $7.50 to $8.25 per 1,000 ft. in 10,000-ft. quantities.

Porcelain.—Demand is very slight with fair stocks on hand. Jobbers' prices are "all over the lot" since the reduction of last month.

Outlet Boxes.—Stocks are about normal, but demand is at a very low point. Discounts offered by jobbers cover an extremely wide range, in lots of 100, varying from 29 to 40 per cent on black boxes and from 21 to 35 per cent on galvanized.

Sockets.—On pulls listing at 60 cents each, keys at 33 cents and keyless at 30 cents jobbers allow from 18 to 20 per cent discount in standard packages. Stocks vary greatly in size but are being held down as much as possible as supplies are not moving very much.

Safety Switches.—Some jobbers report little demand, while others say it is picking up and is fairly good. Stocks are spotty. The Trumbull Electric Manufacturing Company on April 1 reduced the price of safety switches approximately 14 per cent and open knife switches about 10 per cent.

Dry Cells.—Demand is only fair with average stocks on hand. Some talk is heard of the need of lower prices, but quotations remain unchanged, with No. 6 in barrel lots worth 36 cents.

Bells and Buzzers.—Stocks of the small house types carried by jobbers are small and orders are few and far between. Manufacturers' stocks are large, but in several instances production is continuing on the expectation of a demand coming from new building work. Railway types and burglar alarms are moving slightly better than the small sizes. Prices remain unchanged.

CHICAGO

Expected stimulation in the electrical trade has thus far failed to make itself felt in spite of the volume of housing construction that has been put under way in the past few weeks. Building activity has been brought to an abrupt halt by the action of the State Legislature in appointing a committee to investigate all phases of the construction industry in Cook County. Prospective builders are marking time until they see the outcome.

The local situation depends largely on the action of the members of the Chicago Building Trades Council next week. The contractors have submitted a new wage scale based on $1 an hour for skilled labor, a cut of 20 per cent. The acceptance of this scale has been put up to a referendum of the membership, on which the vote is to be taken next Tuesday. An acceptance is anticipated and should be the forerunner of an immense amount of work.

Bare Copper Wire.—Quoted on an 18-cent base to contractors, No. 8 bare copper wire is 18½ to 19 cents per pound in 500-lb. lots and No. 10 is 20½ to 21 cents. Quoted prices are being adhered to by most jobbers, there being less willingness to shade prices in order to get business. A steady and slightly stronger New York market on electrolytic copper has tended to strengthen the local market in copper products.

Insulated Wire.—Rubber-covered wire has shared in the price stiffening process, $8 per 1,000 ft. now being the quoted price on No. 14 in 5,000-ft. quantities, with no price cutting reported. Weatherproof remains on an 18-cent base, with No. 6 triple braid priced at 19 cents in 1,000-lb. quantities. Business in insulated wire is light.

Magnet Wire.—Jobbers report fair business in the more popular sizes with stocks just about right to meet current demand. No. 14 double-cotton-covered is quoted at 29 cents per pound. Prices are firmly held and any variation in the near future should be upward.

Black Conduit.—Demand remains very light and stocks in all hands are approaching the high point. Less disposition is noted, however, to shade prices. The ½-in. size is priced at $64 per 1,000 ft. and 1-in. at $135 per 1,000 ft. in 5,000-lb. lots.

Flexible Armored Conductor.—Demand is very light. Prices are firm, No. 14 two-wire double-strip being priced at $62 to $62.50 per 1,000 ft.

Fuses.—Consumption of fuses has fallen off in proportion to the shrinkage in general manufacturing activity, and all hands hold ample stocks. No price reductions are found, and a rather stronger tendency is noted.

Knobs and Tubes.—Available supply now seems fairly plentiful and prices are considerably firmer, there being absolutely no variation from quoted prices. In barrels the No. 5½ split knob is $18.80 per 1,000. Porcelain tubes, 3 in. x 7/16 in., in barrels, are $8.30 per 1,000.

BOSTON

Business is marking time this week, disturbed labor conditions holding back buying of electrical supplies. Strikes in Boston are influencing interior conditions somewhat. In New England building and engineering contracts for the week ended March 29 totaled $2,770,600. A better feeling is noted in electrical manufacturing circles in this section with the advent of spring. Jobbers are buying lightly and deliveries are good in almost every line. Collections showed a slight improvement in the last week. Stocks are low among distributers and in many lines factory stocks have been accumulated to afford prompt shipment in case of demand arising. Part-time operation continues in not a few industrial plants. House-wiring campaigns in some cities are yielding excellent results.

Wire.—The market is sluggish, with steady prices. Rubber-covered No. 14 is settling at $8 per 1,000 ft. in 5,000-ft. lots; weatherproof is steady at 17 cents base, and demand is light for bare.

Ranges.—Awakening interest in this class of equipment is noted in retail sales departments, and early orders are anticipated for installations to be completed before summer. Distributers report that the outlook is better than for some time.

Motors.—Large stocks have been built up in the factories, and little trouble is experienced in obtaining prompt shipments of virtually all of the commonly used sizes and types including fractional-horsepower machines. Prices show little movement at present.

Flexible Armored Conductor.—A quiet market is evident with fair stocks and little prospect of increased demand until construction work develops better. No. 14 double-strip sells this week at $67 per M in 1,000-ft. lots.

Non-Metallic Flexible Conduit.—Slow sales are reported with steady prices and good stocks within easy reach. For ⅜-in. $22 per 1,000 ft. is being obtained, and the ½-in. size commands $24, both in 5,000-ft. lots.

Dry Cells.—A moderate trade is being handled with ample stocks and steady prices. In barrel lots the No. 6 cells bring $37.35 per 100 and the ignition type $38.35.

Flashlamps.—A fair renewal business is going across the counter and new sales are coming along well. Buying is, of course, light compared with business times, but the staple demand tends to increase.

Appliances.—Vacuum-cleaner sales are reported dull and domestic heating devices are moving very slowly at present. Hand-to-mouth buying is the rule. Popular interest is not abating, however, in washers and ironers. Radiant heaters are at present rather overstocked but good sales are expected in the near future when the fires are let out. Sewing-machine motors are being featured in sales efforts this month. Fans are not being stocked much, many having been carried over from last season. Interest in industrial electric heating equipment is being shown in the interior.

Street-Lighting Equipment.—New life is appearing in this market, owing to interest displayed in communities considering extensions of or improvements to old systems.

ATLANTA

Taken as a whole business shows a slow but nevertheless tangible improvement this week over prior weeks of this year. The spring season has ushered in activities in the farming section and planting is well under way in the southern portion of the state, while the ground is being prepared in the northern portion. Farm labor is reported plentiful and of improved efficiency. As nearly all of the cotton has been put up as collateral on loans, the slight improvement in the sale of it will not put any money in the hands of the sellers but is relieving bank conditions and will tend to make money slightly easier in the section affected. The retail trade in nearly all of the smaller towns is very slow and merchants are loathe to place heavy orders, as they are unable to collect their outstanding accounts.

Building activities are showing a healthy increase, especially in the larger cities. Permits for March in Atlanta number 350, valued at $1,094,000, a value greater than for the two prior months combined. Jobbers report conditions improved in Columbus, Savannah and Albany, though the rest of the section is somewhat quiet, most of the inquiries received at the present time coming from utilities and municipalities. Industrial plants have settled back into an inactive state after an apparent reawakening sixty days ago. A large number of the cotton mills in the section are still shut down or on a part-time basis.

Poles.—The market is very dull, few orders are being placed and even inquiries are scarce. Producers have large stocks on hand, but there is no immediate prospect of fresh activity.

Watt-Hour Meters.—Jobbers have succeeded in accumulating fair stocks of the more popular sizes, which continue to move satisfactorily, the demand being for the 5-amp. and 10-amp., two-wire and three-wire types. No price reductions are to be noted.

Washing Machines.—With heavy stocks on hand, the trade is welcoming a slight increase in the activity of this line. The agitation for a greater margin of profit continues to be the subject of much discussion among the retailers.

Lightning Arresters.—A price reduction of 15 per cent on the compression type, 2,300 volts, is reported this week. The approaching summer season is causing a brisk movement in this line, and stocks are reported in good condition.

Pole-Line Material.—Though poles are not moving, crossarms, hardware and insulators are reported fairly active. Jobbers' stocks are in excellent shape. Prices, standard fir arms, four-pin, 4-ft., 78 cents; braces, ⅜-in. x 24 in., $17.92 per 100; pins, ¼-in. x 8 in., $4 per 100; brackets, $4.28 per 100.

Switch and Outlet Boxes.—While the volume is small, steady orders are being received for this line. Local stocks are in good condition, with prices on switch boxes at 28 cents for the single-gang type, 50 cents for the double-gang.

Wire.—Rubber-covered continues to be the more active, though weatherproof is being moved in sizes Nos. 6, 8 and 10. Local stocks are in good shape, with prices for rubber-covered on a 16-cent base and weatherproof on a 15½-cent base.

Heating Devices.—No movement in this line is reported, while jobbers throughout the section are still found with very heavy stocks on hand. This is particularly true of flatirons, though this item should begin to show signs of life in the next thirty days.

ST. LOUIS

Construction work awaits only a reduction in labor costs to open up in substantial manner, but the wage situation, contrary to expectations, is becoming more difficult rather than better. The building contractors and the unions are not only getting nowhere in their negotiations but a lockout in the concrete trade is now reported because the men will not accept a reduction in wages. Sales of electrical goods will probably continue to show gradual improvement, but are not expected to be generally normal until the wage difficulty is settled.

Some apprehension was felt over the recent freezing weather, but it is reported that wheat and other crops were not injured and only the early fruit crop was affected. The effect on the electrical industry will probably be nil.

No changes in prices for the week are reported. Stocks where heavy are gradually being reduced. Slight increase in demand is noted, and while jobbers and dealers are by no means jubilant, they are fairly content with the situation and look to the future with confidence.

Wire.—No. 14 rubber-covered is selling satisfactorily, but the larger sizes are moving slowly. The price as a rule is from $7.50 to $8.10 per 1,000 ft., but one instance is reported where a large block was sold for $7. A fair demand for bare and weatherproof is found. Bare wire is selling on a 15½-cent to 16½-cent base, but one jobber has quoted on a 14-cent base. Weatherproof is selling on a 16-cent base. Stocks in these three kinds are in good condition.

Flexible Armored Conductor.—Stocks are rather heavy and the demand is slow; No. 14 is quoted from $65 to $80 per 1,000 ft.

Magnet Wire.—The market for magnet wire is virtually dead, manufacturers having enough on hand to take care of the requirements for some time. Jobbers' stocks are being kept down. Quotations are on an 18-cent base.

Lamp Cord.—This is selling fairly well in a very competitive market. No. 18 cotton twisted is selling at $17.50 per 1,000 ft. and No. 18 silk at $33.45 per 1,000 ft.

Schedule Material.—Stocks are spotty and selling is on a close basis. Movement is very slow in most items.

Insulators.—Demand for glass insulators is quite dull, stocks are in good shape and no change in price has been reported for some time. The demand for porcelain insulators is good and shows improvement. Stocks are practically exhausted and thirty-day to sixty-day deliveries are offered.

Fuses.—The demand for fuses is better than it has been for the last six months and they are selling well. Stocks are complete and in good condition.

Poles and Cross-Arms. — Pole-line construction shows more activity than any other line. Inquiries are on a normal basis and attractive orders are appearing. A number of municipalities within a 100-mile radius of Keokuk are interested in obtaining water power, and some bond issues are being promulgated. Ranier fir arms, 3¼ in. x 4¼ in., are quoted as follows: Two-pin, $46.73 per 100; four-pin, $62.30; six-pin, $93.46—all for quantities over 1,000 arms. In quantities less than 1,000 the two-pin arm is quoted at $52.57.

Ranges.—A 20 per cent increase in residential gas rates just announced may tend to stimulate local range sales, but the demand at present is extremely dull.

SEATTLE—PORTLAND

Prospects for 1921 crops of all kinds in the Northwest are reported as exceptionally favorable. Wheat has come through the winter satisfactorily, and there will be virtually no re-seeding. Opportune rains and warm weather have caused deciduous fruit trees to bud and blossom profusely, and if unseasonable frosts do not occur, their yields should be record ones. Lumber mills in this district continue gradually reopening, but production is still only about 42 per cent of normal period. Reductions announced in transcontinental freight rates to St. Paul, Omaha and Chicago, as well as charter rates to the Orient, are expected to benefit lumber manufacturing interests, and prospects for the remainder of the year are bright. The peak of non-employment has been passed, and resumption of operations in mills and logging camps and the Alaska mines, coupled with the beginning of agricultural activities, is gradually relieving the congestion in the cities.

Manufacturers in both the Seattle and Portland fields report conditions practically unchanged and prospects very poor for any material improvement before well along into the second quarter. Jobbers say that business is far from brisk. Short buying is still the rule, owing both to a continuation of the buyers' strike and a feeling by the dealer that prices have not reached the bottom. As if in response to this feeling, prices continue tending downward, although the decline is very gradual. During the past week reductions were noted in porcelain, fuses, conduit, telephones, bells, buzzers, etc.

Heaters.—Jobbers have full stocks, and it will probably be necessary to sacrifice them at less than cost to move them. Demand is negligible.

Ranges.—Demand has not shown the increase predicted; if anything, the movement has slowed up. Stocks of all standard lines are reported in good condition and replenishments are easily obtainable.

Vacuum Cleaners.—During the past week in Seattle both jobbers and dealers have reported a considerable increase in sales, and it is believed the long-anticipated movement has actually started. All types are in fine shape. Prices have shown no recent chance.

Schedule Material.—Demand is showing a slight increase from week to week; still the volume is not nearly as large as anticipated. Building gives every indication of beginning, but the major portion of new construction is confined to homes.

SAN FRANCISCO

In glancing around the larger California cities there is noted a surprising amount of large building which is now about ready for the electrical work. However, there is a shortage of jobs just now; for while a number of permits are being issued it appears that many of them are being held over. Counter business picked up considerably during the last two weeks of March and appliances are moving much better. Manufacturers, jobbers and dealers have combined to restore confidence in the market and to convince the public of the justice of prevailing prices, and a healthier tone is manifested.

Collections are good. Particular attention is being paid to a common-sense method of accounting to be used uniformly by electrical dealers. Several of the jobbers have supplemented the staffs of their credit departments by the addition of a sort of traveling accountant. It is predicted that the prosperity of districts dependent upon certain fruits, vegetables and nuts, will be seriously affected by the inability of packers and growers' associations to come to terms over standard prices. This has resulted in the carrying over of huge stores of unmarketed fruit into 1921. Packing and canning firms have curtailed their operations.

Poles.—One class of customer that is buying heavily at the present time is the power companies. Many carload orders of poles have been received for shipment to various companies. Local stocks are small and for emergency purposes only. The orders received are for direct shipment from the mills in the Pacific Northwest. About fourteen carloads of poles have been ordered during the last week or so.

Cross-Arms.—In this line, too, many good sales are reported. Deliveries are now good because of the gradual restoration of better labor conditions and normal business at the mills.

SALT LAKE CITY—DENVER

The industrial event of outstanding significance in the Intermountain section is the complete shutdown of the copper mines. Operations are at a standstill, and when activities will resume no one ventures to say. Electrical men, along with all other classes of merchants and jobbers, are going to be both directly and indirectly affected as the copper mines have been large users of energy. The cessation of mining work will thus create a surplus of energy that it will be difficult to divert without some radical readjustments. The copper companies have also been among the best and most regular customers of jobbers for electrical materials and equipment. This large demand will cease forthwith and leave merchants seeking new outlets.

The indirect effect will be an immediate and marked falling off in the demand for line materials and electrical supplies on the part of the central stations. It is felt that there will be months ahead of marking time and retrenching in building and construction work. In spite of the new discouragement, however, business men are determined to push ahead and to bring about the much-needed regeneration in trade and commerce. In late months they have acquired the habit of optimism and are not disposed to be downhearted over the calamity to the copper industry. A movement that is being watched with eager interest is the boring for oil in southeastern Utah by the National Oil Corporation. If oil is found in commercial quantities, electric companies will immediately construct lines to the bases of operation. This will mean electric service to hundreds of new homes and a boom in the electric industry generally. Collections are unimproved. Shipments are good and jobbers' and dealers' stocks generally satisfactory. Noticeable improvement has been made in the building situation, interest being especially shown in the construction of new homes and apartment houses in the larger cities.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

Doubled Capacity of Colonial Chandelier Works

With its plant running full and even for a couple hours at night, the Colonial Chandelier Works, 122 Center Street, New York, is making alterations and adding machines which will about double the capacity. At the same time, the company is extending its distribution through electrical supply jobbers throughout the Eastern and Middle Wstern States.

Improved Stock Service for Piedmont Electric

The Piedmont Electric Company, Ashville, N. C., announces that it has been made direct factory representative in its territory of Duncan meters and transformers. This jobber has sold these products exclusively for fourteen years, but now it expects to be able to give better service under its new arrangements. It can make immediate warehouse shipments on transformers up to 10 kw. in standard voltages and alternating-current meters in single-phase and three-phase up to 50 amps.

Gregory Electric's Balance Sheet Favorable

The Gregory Electric Company, Sixteenth and Wood Streets, Chicago, dealer in used electrical machinery, shows a surplus as of March 1, 1921, of $258,756, as against $204,413 on that date of 1920 and $203,542 in 1919. Total assets on those respective dates amounted to $790,681, $498,685 and $475,351. On March 1, 1921, materials, supplies and stock in process of manufacture were worth $267,864. The company's earnings were high in 1916 and 1917, but dropped off in 1918 and again in 1919. In 1920 they advanced again 33 per cent.

Another Citation on Alleged Unfair Competition

Upon application for the issuance of a complaint, the Federal Trade Commission has, as required by law, the public interest appearing, cited the Standard Electric Manufacturing Company, Chicago, in complaint for the use of tying contracts and unfair competitive methods in the manufacture and sale of electric appliances in interstate commerce.

The tying feature of the contract to which the complaint is directed provides that customers of the Standard Electric Manufacturing Company agree not to solicit orders for or to sell goods of any kind or character that will compete with the goods of the respondent. In consideration of this tying feature the complaint further shows that the Standard company allows a discount of 10 per cent to those of its customers who faithfully perform this contract and refrain from handling competing lines of goods. The complaint avers that this practice lessens competition.

The complaint is also directed to the company's system of fixing prices at which its appliances are sold upon condition that its customers will maintain such standard prices fixed by the company. Thirty days are allowed for filing answer, after which time the case will be heard on its merits on May 17, or as soon thereafter as it can be reached on the calendar.

Larger Space Bought by Bullock Manufacturing Company

When the Bullock Manufacturing Company moves into the building it has just purchased at 356-358 West Fortieth Street, New York, in July or August, it will have available for manufacturing lighting fixtures and equipment about 150 per cent more space than it has at present at its works at 408 West Thirteenth Street. Whether all this space will be used for this purpose will be determined by business conditions later in the summer. The company is working full time now and has a good volume booked ahead. The new building is six stories, 40 ft. x 50 ft.

Trumbull's February Billings Good

February of last year was supposed to be a pretty good month in the electrical business. February of this year couldn't have been so bad for the Trumbull Electric Manufacturing Company, Plainville, Conn., for, according to the March *Trumbull Cheer*, the company's factory output for February, 1921, was ahead of that of February, 1920. The company billed out more stuff this February than last.

Graton & Knight's 1920 Business High

In its annual report for the year ended Dec. 31, 1920, the Graton & Knight Manufacturing Company, Worcester, Mass., leather-belt manufacturers, states that it has rounded out the year with its sales by far the best in its history, with the single exception of the war contract period in 1918. The year ended with the company in a strong financial position. The loss sustained by shrinkage in value of inventories has been considerably offset by strenuous sales efforts and by reduction in the production costs and general overhead expenses. January of the present year shows considerable improvement in business over December, 1920—the company's low point—and February and March have shown still further improvement. The present financial position also shows a decided improvement over that of Dec. 31 by reason of a substantial reduction in the liabilities. Surplus, after allowing for plant values, amount to $3,929,862.

Reorganization of Consulting Engineers' Business

Johnson & Benham, Inc., consulting engineers of New York and Kansas City, Mo., announce the reorganization of the business. All contracts and business of the New York office have been taken over by the George A. Johnson Company, Inc., the members thereof being George A. Johnson, Harold C. Stevens, Nelson B. Wolfe, Charles R. Wyckoff and Harry B. Joyce. The main offices of the corporation are at 150 Nassau Street, New York. All contracts and business of the Kansas City office have been taken over by Benham & Mullergren, a partnership consisting of Webster L. Benham and Arthur L. Mullergren, with offices in the Firestone Building, Kansas City.

New House Organ of Hygrade Lamp Company

The Hygrade Lamp Company, Salem, Mass., is issuing through its lamp distributers and jobbers a new house organ called the *Hygrade Triangle*. The sheet is for the purpose of giving news about lamps and lighting and also facts about Hygrade lamps.

Royal Electric Adds Air-Break Switch Line

The Royal Electric Manufacturing Company, Chicago, is adding to its products a line of pole-type, vertical-air-break switches, with remote mechanical control designed for rural service line use. The switches will be supplied in capacities up to 150 amp. and at voltages up to 16,500 and will be equipped with fuses, choke coils and series lightning arresters with series resistance.

Gray & Davis Looks for Good Operating Profits

In the annual report of Gray & Davis, Inc., Cambridge, Mass., for the year ended Dec. 31, 1920, sales for the seven months ended July 31 for both the Cambridge and Amesbury plants are stated to have been $2,806,190. Net loss on this operation amounted to $463,100. In this period, however, no depreciation charges were included. On Aug. 1, the company entered into a sales contract with the American Bosch Magneto Corporation under which contract the Bosch company became the selling agent for the product of the Gray &

Davis Cambridge plant. At this time the Bosch company assumed control of the manufacturing operations both at the Cambridge and Amesbury plants, and during the last five months of the year worked at revamping manufacturing processes and generally getting both plants in the best possible physical shape for economical operation. As of Dec. 31, unfilled orders on the books of Gray & Davis, Inc., amounted to $4,111,-124.

During the last five months of 1920 sales at the two plants amounted to $1,293,490, while net operating loss showed $4,998 after charging into production costs depreciations of $91,824. Shipments were curtailed almost entirely during the last three months of the year. With the inventories written at replacement value and with manufacturing processes revamped, the company feels that it is safe to assume that immediately business starts in any reasonable volume very satisfactory profits will be forthcoming.

Electric Box & Cover Company Organized from Metals Stamping Company

The new name of the Metals Stamping & Manufacturing Company, Inc., 29 Avenue C, Newark, N. J., is the Electric Box & Cover Company. In addition to manufacturing various metal parts the new company is making electric outlet boxes and covers. Albert J. Slap is at the head of sales.

Laundryette Publishes Sales Bulletin

The Laundryette Manufacturing Company, 1190 East One Hundred and Fifty-second Street, Cleveland, announces the recent publication of the first number of its new sales bulletin to be known as the "Dryer." This little bearer of advertising and selling ideas will be sent from time to time to each "Laun-Dry-Ette" dealer.

J. F. Buchanan's Jobbing Business Being Expanded

In line with plans to extend the wholesale end of its business and to keep pace with its development, the J. F. Buchanan Supply Company, 1719 Chestnut Street, Philadelphia, has appointed A. M. Little as its manager, as announced on page 792 of last week's ELECTRICAL WORLD. At present the company's wholesale stock is in buildings at the rear of its retail store at 1715 Chestnut Street, but it is planned under Mr. Little's supervision to secure a modern, well-appointed building in the wholsale district into which the wholesale stock, offices, etc., will be moved and the jobbing business carried on. At the present location the retail, contracting and repair business will be continued as a separate business under the name J. F. Buchanan Company, buying as such from the J. F. Buchanan Supply Company.

The Supply company believes that in its relations with dealers it will have the advantage of the experience of its own retail department to act as a guide in offering to other dealers advice and service.

Delta-Star Expands Sales Organization

The Delta-Star Electric Company, 2433 Fulton Street, Chicago, has recently opened offices in the Interstate Building, Kansas City, Mo., and at 411 South Main Street, Los Angeles, Cal. The Rochester (N. Y.) office has been transferred from the E. & B. Building to larger quarters in the Chamber of Commerce Building.

Million-Dollar Order for Springfield Boilers

The order for the boilers for the new Hell Gate station of the United Electric Light & Power Company, New York, went to the Springfield Boiler Company, Springfield, Ill. This order, it was learned, ran in excess of $1,000,-000. These boilers, which will be among the largest in existence, will have a rating of 1,890 hp. So far but twelve boilers have been ordered, but provision has been made for twenty-four ultimately.

Holdings of International Combustion Engineering Corporation

What has been characterized as one of the biggest accomplishments in the development of stoker business and combustion business generally thus far is the organization of the International Combustion Engineering Corporation to control the Combustion Engineering Corporation of New York and the Underfeed Stoker Company, Ltd., of London, England. It owns almost all the stock of both these companies and of course controls also their subsidiary companies and representatives. The Underfeed company occupies in England a position similar to that of the Combustion company in this country, and the former company has agencies and representatives throughout the world.

Austin Machinery to Rebuild Burned Plant

Announcement is made by the Austin Machinery Corporation, 609 Railway Exchange Building, Chicago, that the plant recently destroyed by fire at Winthrop Harbor, Ill., will be rebuilt. This is deemed advisable as the location of this plant particularly facilitates production for the West and Northwest territory. The company has developed a group of subsidiary corporations and large agencies with extensive warehouses carrying stocks in order to overcome the delays incident to late spring and summer ordering. The plant of the Fairmont Mining Machinery Company, Fairmont, W. Va., where extensive improvements are planned, has recently become one of those comprised in this consolidated group.

The Runzel-Lenz Electric Manufacturing Company, 1751-55 North Western Avenue, Chicago, is reported to have awarded a contract for a two-story addition to its plant, to cost about $20,000. The company manufactures lamp cords and annunciator wire.

The Edward Valve & Manufacturing Company, 72 West Adams Street, Chicago, is reported to be making arrangements to rebuild the portion of its East Chicago (Ind.) plant recently destroyed by fire. Cost is estimated at $350,000.

The Wolke Lead Batteries Company, Louisville, Ky., successor to the Peerless Storage Battery Company, has filed notice of increase in capital stock from $500,000 to $1,250,000, the proceeds to be used for expansion purposes.

Daniel J. P. Jones, formerly connected with the Chicago office of the Economy Fuse & Manufacturing Company, has been appointed sales representative of the company in Michigan and will have his headquarters in Grand Rapids.

The Trammell Electric Lamp Company, 21 South Broad Street, Atlanta, Ga., has made arrangements with the Lux Manufacturing Company, Hoboken, N. J., manufacturer of tungsten and nitrogen lamps, to distribute its products in the Atlanta district.

The Sampson Manufacturing Company, 4244 West Lake Street, Chicago, manufacturer of electric and gas fixtures, has completed plans for the erection of a one-story plant, 40 ft. x 125 ft., on West Lake Street, to replace a building recently destroyed by fire.

The Michigan Stamping Company, 3171 Bellevue Avenue, Detroit, has awarded contract for construction of a one-story factory, 60 ft. x 480 ft., on Bellevue Avenue.

The Power Manufacturing Company, Marion, Ohio, manufacturer of Primm heavy-duty oil engines, has established an office at 114 Liberty Street, New York City, in charge of H. L. Dean.

The Morgan-Gardner Electric Company, Chicago, has removed its general offices to its plant at 2624 Shields Avenue.

The Binghamton Electric Truck Company, Binghamton, N. Y., has filed notice of increase in capital stock from $200,000 to $1,200,000.

The Tafel Electric Company, Louisville, Ky., has filed notice of increase in capital stock from $150,000 to $175,-000.

The Crocker-Wheeler Company, Ampere, N. J., has moved its Boston office to 171 High Street (Cornhill Square), where it has larger quarters. L. S. Howland continues as district manager.

The Buffalo Chandelier Corporation, Buffalo, N. Y., has filed notice of increase in capital stock from $50,000 to $125,000.

The Ames Iron Works, Oswego, N. Y., will early in April establish direct branch sales and service offices at 1033-1035 Commercial Trust Building, Philadelphia, under direction of E. A. Hahl and H. Schluter as district managers.

Foreign Trade Notes

ELECTRIFYING ROUMANIAN RAILROADS.—The Bukarest government is considering the electrification of a number of its railroads. Large orders have already been placed in Germany, the Orenstein-Koppel Works alone having received orders to the amount of 90,000,000 marks. It is reported that additional orders will be placed in the near future.

SWEDISH COMMISSION TO STUDY SWISS ELECTRIFICATION. — Advices from Switzerland state that during the next few weeks a commission of foreign engineers will visit Switzerland for the purpose of studying the electrification of the Swiss railroads. The commission will be composed of three American and three Swedish engineers. Mr. Oefverholmen, the Director General of the Swedish State Railways, heads the commission. The foreign engineers will inspect the Gotthard and Lotschberg lines and the large new power stations on both of these lines.

DEVELOPMENT OF WATER POWER IN FINLAND.—It is stated on advice from Switzerland that of all the States formerly belonging to the Russian Empire, none is making such efforts to improve its economic and industrial conditions as Finland. This country is extremely rich in water power, and the Finnish Diet has now passed a law according to which the great waterfalls at Imatra and Aujala will be exploited for industrial purposes. Large power stations will be erected at a cost of 300,000,000 Finnish marks, which amount has been appropriated by the Diet. It is expected that the electrification of the railroads will also be started in the near future.

NEW MUNICIPAL ELECTRIC PLANT PROPOSED FOR SYDNEY, AUSTRALIA. —According to the report of Forbes Mackay, city electrical engineer, to the City Council of Sydney, Australia, the present municipal electric plant will have reached its limits of supply by 1925, and as there is no room for further extension on the Pyrmont site, a complete new building and plant must be provided. The purchase of one of the coal mines south of Sydney and the locating of the proposed plant there has been recommended. The cost of the plant completed is estimated at between £4,000,000 and £5,000,000.

DEVELOPMENT OF CHILEAN WATER-POWER RESOURCES.—The water power resources in the central provinces of Chile, according to *Electrical Industries*, are to be utilized to generate electricity for Santiago, Valparaiso and neighboring cities and towns. A company, capitalized at $3,250,000, has been organized for the purpose, and work has been started on a hydro-electric plant on the Colorado River, near Santiago, where it is expected that 18,000 hp. can be developed. The project is backed largely by Chilean capital. Until recently no water-power concessions in Chile were granted by the President of the Republic for more than thirty-five years, but the latest concessions are said to be perpetual.

DEMAND FOR ELECTRICAL GOODS IN SIAM.—Owing to the fact that no electrical apparatus of any kind is manufactured in Siam there is a demand for all classes of electrical goods with the addition of specialties needed for a tropical country. Bangkok, according to Carl C. Hansen, vice-consul, is the only city furnished with electric light and power stations, of which there are two, the Siam Electricity Company, Ltd., and the Samsen Power station. The customs records show that the United States, with exports of nearly $90,000, was the heaviest contributor to the imports of electrical goods during the calendar year 1920. Electric lighting sets of various makes and sizes are advertised in the local press, but the demand seems to be moderate and limited to the provinces. The import duty on all electrical goods is 3 per cent ad valorem.

DEVELOPMENT OF WATER POWER IN QUEENSLAND RECOMMENDED. — A final report submitted by Mr. Crowley, a government expert, on the water-power possibilities of Queensland, Australia, according to *Engineering*, states that the northern hydro-electric scheme is capable of developing about 50,000 hp. He recommends that surveys be made at once of the Barron, Mount Spec and Mackay waters and advises that the first work should be done on the Barron River. If possible, surveys should be made simultaneously of the Mount Spec and Mackay waters. Then plans should be prepared and tenders called for the initial 10,000-hp. plant with provision for three others as soon as wanted. If the plants were built, the Barron and Tully Rivers would act as main feeders for the northern system.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A mercantile firm in India (No. 34,632) desires to purchase and secure an agency for everything electrical, electric passenger and freight elevators, etc.

A firm of commercial agents in Australia (No. 34,633) desires to secure the exclusive representation of manufacturers for the sale of electrical and ventilating machinery as well as motors and accessories.

A trading company in Australia (No. 34,645) desires to secure an agency for the sale of all classes of electrical goods, switches, holders, connections, lamps, motors and generators (large and small). The voltage principally used is 240.

New Apparatus and Publications

SOLDER.—The Union Smelting & Refining Company, Inc., St. Charles Street, Newark, N. J., is putting out a new handy-package "Usarco" solder in stick form for electrical use.

ELECTRIC VEHICLE WHEEL. — The Electric Wheel Company (Associates) has designed a new electric motor in the wheel drive for commercial and industrial trucks.

STEEL TOWERS.—Archbold-Brady Company, Syracuse, N. Y., has issued a pamphlet on the transmission lines of the Niagara Falls Power Company.

ACCEPTANCES. — "Acceptances, Trade and Bankers'" is the title of a new book just published by D. Appleton & Company, New York City, written by Park Mathewson, vice-president of the Business Bourse, New York.

OVERHEAD EXPENSES.—Chamber of Commerce of the United States of America, Mills Building, Washington, D. C., has just issued a pamphlet on "Overhead Expenses: How to Distribute Them in Good and Bad Times."

HIGH-TENSION SWITCHES. — The Royal Electric Manufacturing Company, Chicago, is issuing bulletins Nos. 20 and 25 inclusive, describing a new line of air-break switch, fuse and lightning arrester equipment for farm-service lines, high-tension air-break switch equipment and outdoor bus supports.

MILL-TYPE LAMP.—A new tipless mill-type lamp for rough service, 25-watt and 50-watt sizes, 110 volts and 220 volts, has been brought out by the Hygrade Lamp Company, Salem, Mass.

TRADEMARKS. — "The Work of the Trade-Mark Bureau" is the title of a booklet distributed by Mida's Trade-Mark Bureau, Ellsworth Building, Chicago.

SWITCHBOARDS.—The General Electric Company has issued bulletin No. 47,030A, superseding bulletin No. 47,030, entitled "Switchboards for Merchant Ships."

EVAPORATORS. — "Lillie Evaporators for Waste Waters and Solutions Generally" is the title of bulletin 11 distributed by the Wheeler Condenser & Engineering Company, Carteret, N. J., describing the Lillie evaporator.

RADIO BATTERY.—The Ship Owners' Radio Service, Inc., 80 Washington Street, New York City, is distributing a four-page leaflet describing its "Sorsinc" new "B" battery, designed for tube transmission and reception purposes.

PLUGS AND RECEPTACLE HOUSINGS. —The Crouse-Hinds Company, Syracuse, N. Y., is distributing a four-page pamphlet covering its BRJ receptacle housings, MK series of condulets and MF switches.

POWER TRANSMISSION DEVICES.— "Link-Belt Silent Chain" is the title of data book No. 12, being distributed by the Link-Belt Company, Chicago. The company has also issued book No. 425 on textile machinery and bulletin No. 282 on the dye-making industry.

ELECTRIC SNOW MACHINE.—The B. L. Schmidt Company, Davenport, Iowa, has recently placed on the market its "Little Giant" No. 45 electric snow machine for soda fountains.

BATTERY HANDLES. — The Mueller Electric Company, 2135-45 Fairmount Road, Cleveland, is distributing circular No. 57, describing its No. 6-A battery handle. The company has also recently developed two battery handles of the wire type, known as No. 7-A and 9-A.

SWITCHBOARD.—A new type of dead front and rear switchboard has been brought out by the Krantz department of the Westinghouse Electric & Manufacturing Company, suitable for any capacity up to 600 amp., 250 volts, direct current, and up to 1,000 amp., 600 volts, alternating current.

INSTRUMENTS.—The Hickok Electrical Instrument Company, Cleveland, is distributing bulletin No. 20, describing the Hickok miniature ammeters, voltmeters and wattmeters.

BELL RINGER BATTERY. — The National Carbon Company, Cleveland, has recently placed on the market a dry-cell battery of two-cell power, known as the Columbia ringer battery.

SOCKETS.—The Gibson Electric Manufacturing Company, 118 South Forty-third Street, Philadelphia, is distributing a new catalog sheet covering its miniature and candelabra socket specialties.

VALVES.—The Rensselaer Valve Company, Troy, N. Y., is distributing book No. 12, describing its "Rensselaer" throttle and control valves.

INSULATING FABRIC. — A non-woven fabric sheet and tape for insulating purposes, "Voltape," has been developed by the Res-Pro Industries, Inc., 209 Washington Street, Boston.

New Companies

THE MINIATURE BREAKER COMPANY, New York, N. Y., has been organized by F. A. Cole and C. H. Aborn, 45 John Street, to manufacture circuit breakers and other electrical equipment.

THE NEWARK IGNITION COMPANY, N. J., has been incorporated by Joseph M. Maier, Jacob Lubetkin and Harry Landskroner, 32 William Street. The company is capitalized at $125,000 and proposes to manufacture magnetos and ignition equipment.

THE THREMO ELECTRIC, LTD., Brantford, Ont., has been incorporated by James Harley, Edmund Sweet, Archibald M. Harley and others. The company is capitalized at $60,000 and proposes to manufacture electric machinery, apparatus, etc.

MATSON & COMPANY, LTD., Aurora, Ont., has been incorporated by William H. Bushell, Reginald R. Matson, William G. Cole and others. The company is capitalized at $40,000 and proposes to manufacture electrical fixtures, machinery, motors, tools, etc.

THE ROMER MOTORS CORPORATION, Boston, Mass., has been incorporated by Albert J. Romer, Boston; J. Ellis Nightingale, Danvers, James L. Roope, Salem. The company is capitalized at $5,000,000 and proposes to manufacture motors, steam, gas and electric engines.

THE STORAGE BATTERY, PARTS & EQUIPMENT COMPANY, Poughkeepsie, N. Y., has been incorporated with a capital stock of $50,000 by H. Eggleston, J. W Bitts and W. S. Lent.

THE PARAMOUNT LIGHTING FIXTURES CORPORATION, New York, N. Y., has been incorporated with a capital stock of $30,000 by M. Geringer, H. A. Safion and J. J. Gans, 302 Broadway.

THE ELECTRO SERVICE COMPANY, INC., Hoboken, N. J., has been incorporated with a capital stock of $5,000 by Ernest and Albert J. Casper, 413 Jane Street, Hoboken. The company proposes to manufacture and deal in electrical equipment and supplies.

THE NEW JERSEY ELECTRIC LAUNDRY COMPANY, Keyport, N. J., has been chartered with a capital of $100,000 by Phillips and Earl H. Cherry and Leroy W. Bouton.

THE RIGSBEE ELECTRIC COMPANY, Dallas, Tex., has been incorporated with a capital stock of $35,000 by A. R. Rigsbee, W. A. Schnabel and T. L. Farmer.

Record of Electrical Patents

Notes on United States Patents

(Issued March 15, 1921)

1,371,749. TELEPHONE EXCHANGE SYSTEM; Clarence B. Fowler, New York, N. Y. App. filed Jan. 24, 1919. To improve signaling.

1,371,757. WIRELESS-TELEGRAPH RECEIVER; Ernest W. B. Gill, Oxford, England. App. filed Oct. 7, 1920. Audion.

1,371,782. ELECTRIC SWITCH; Frederic P. Gates, Hartford, Conn. App. filed Nov. 20, 1917. Socket pull switch.

1,371,789. METHOD OF PRODUCING NITRIC ACID; Yoshinao Kawakita, Kamoto-Gun, Kumamoto-Ken, Japan. App. filed April 2, 1918. Electric spark discharges through mixed gas of nitrogen and oxygen.

1,371,797. IGNITION SYSTEM FOR ENGINES; Alva C. McCandless and Daniel L. Harris, Wichita, Kan. App. filed April 12, 1920. Movement of piston of engine for causing a spark.

1,371,814. WATER-TREATING APPARATUS; John Roche and Raymond J. Parker, Buffalo, N. Y. App. filed Feb. 7, 1919. Purifying, softening or otherwise treating water.

1,371,825. MAGNETIC SEPARATOR; Franz Uhlig, Berlin, Germany. App. filed March 16, 1920. Material falls directly on or close to magnet.

1,371,826. METHOD OF ELECTROLYTICALLY PRECIPITATING METALS AND COMPOUNDS FROM SOLUTIONS; George D. Van Arsdale and Charles G. Maier, New York, N. Y. App. filed May 13, 1918. Depolarizers.

1,371,855. INSULATOR; Henry W. Buller, Fremont, Neb. App. filed April 5, 1918. No tie wire required.

1,371,874. TELEPHONE SWITCHING CABINET; John H. Ditch and William T. Burns, Altoona, Pa. App. filed Jan. 25, 1916. Railway block offices.

1,371,894. BATTERY-CELL CONSTRUCTION; Walter E. Holland, Philadelphia, Pa. App. filed Jan. 29, 1920. Simple, inexpensive and relatively flexible sealing joint.

1,371,895. BATTERY-CELL COVER; Walter E. Holland, Philadelphia, Pa. App. filed July 13, 1920. Readily molded to accurate dimensions.

1,371,907. ELECTRODE TERMINAL; Harry M. Koretzky, New York, N. Y. App. filed June 30, 1920. For dry cells.

1,371,935. TIME-CONTROLLED ELECTRIC SWITCH; Jacob Rubin, Charleston, W. Va. App. filed Feb. 6, 1919.

1,371,966. STARTING DEVICE FOR VAPOR CONVERTERS; Alfred L. Atherton, Edgewood Park, Pa. App. filed Nov. 29, 1915. Auxiliary anode and cathode in contact and in series with tilting magnet.

1,371,990. AUTOMATIC CUT-OUT APPARATUS; James K. Delano, New York, N. Y. App. filed Feb. 25, 1918. For automobile.

1,371,994. DIRECT-CURRENT TRANSFORMER; Arthur F. Nesbit, Wilkinsburg, Pa. App. filed April 25, 1917. Direct current of any voltage from alternating current.

1,371,997. MANUFACTURE OF SUGAR DIRECT FROM THE JUICE; Elie Delafond, Havana, Cuba. App. filed July 24, 1920. Cane juice purified by electric current.

1,371,998. ELECTRIC STORAGE BATTERY; Walter Lawrence Gill, San Bernardino, Cal. App. filed April 23, 1920. For starting, lighting and ignition systems.

(Issued March 22, 1921)

15,067 (reissue). BATTERY AND SEPARATOR-THEREFOR; Frank T. Baird, Blue Island, Ill. App. filed Sept. 17, 1918. Highly permeable separator.

15,068 (reissue). AUTOMATIC TELEPHONE SWITCHING APPARATUS; John G. Blessing, Chicago, Ill. App. filed July 6, 1915. Step-by-step.

15,070 (reissue). SUBSTATION TELEPHONE CIRCUITS; Bernard D. Willis, Chicago, Ill. App. filed Aug. 19, 1919. Automatic.

1,372,042. DESK OPERATOR'S CIRCUITS; William A. Rhodes, New York, N. Y. App. filed Dec. 5, 1918. Telephone.

1,372,050. BUSY-SIGNAL-TESTING APPARATUS; John F. Toomey, New York, N. Y. App. filed April 4, 1919. Telephone.

1,372,091. LIMITER FOR ALTERNATING CURRENTS; Salvatore Salto, Milan, Italy. App. filed Feb. 15, 1919. Opens circuit on overload and recloses when overload is removed.

1,372,096. ELECTRICAL SYSTEM OF DISTRIBUTION; Marcellus R. Shedd, Lancaster, N. Y. App. filed Nov. 23, 1915. Improved regulation where storage battery is charged by generator.

1,372,097. ELECTRICAL REGULATOR; Marcellus R. Shedd, Lancaster, N. Y. App. filed Nov. 23, 1915. To vary resistance of circuit by carbon pile.

1,372,110. X-RAY APPARATUS; Sinclair Tousey, Westhampton Beach, N. Y. App. filed April 10, 1910. For improving radiographs.

1,372,162. MUFFLER ATTACHMENT FOR TELEPHONES; David Petri-Palmedo, Bridgeport, Conn. App. filed May 27, 1920. Use of telephone in presence of others without being overheard.

1,372,170. RESHARPENING OF FILES, RASPS AND THE LIKE; Sidney T. Judd, Lewisham, London, England. App. filed Jan. 26, 1921. By electrolytic action.

1,372,202. FREQUENCY MULTIPLIER; Isaac Schoenberg, London, England. App. filed Oct. 7, 1916. Frequency multiplied by single apparatus having no moving parts.

1,372,203. FREQUENCY MULTIPLIER; Isaac Schoenberg, London, England. App. filed Oct. 7, 1916. Frequency multiplied by single apparatus having no moving parts.

1,372,287. CHUCK; Bengt M. W. Hanson, Hartford, Conn. App. filed July 31, 1918. Magnetic chuck.

1,372,288. ELECTRICAL ATTACHMENT PLUG; Axel E. Hellerstedt, Great Falls, Mont. App. filed April 1, 1918. Screw plug.

1,372,330. RESISTANCE ELEMENT; Thaddeus F. Baily and Frank T. Cope, Alliance, Ohio. App. filed April 3, 1919. For electric furnaces.

1,372,361. SAFETY DEVICE FOR ELECTRIC IRONS; Thomas Martin, Vancouver, British Columbia, Canada. App. filed May 13, 1920. Fusible plug.

1,372,366. BRUSH CONNECTION; Philip P. Nungesser, Cleveland Heights, Ohio. App. filed June 23, 1919. Pigtail connection.

1,372,421. HAIR-CURLING DEVICE; Violet G. Grenall, New York, N. Y. App. filed Sept. 5, 1919. Electrically heated.

1,372,425. SYSTEM OF RADIO TELEGRAPHY AND TELEPHONY; John Hays Hammond, Jr., Gloucester, Mass. App. filed June 15, 1912. Simultaneous operation of two or more high-powered wireless stations in same neighborhood without interfering.

1,372,426. MULTIPLEX RADIOTELEPHONY; John Hays Hammond, Jr., Gloucester, Mass. App. filed May 29, 1912. One generator for the waves of any required number of sets.

1,372,432. APPARATUS FOR ELECTRIC WELDING; Edward W. Jansen, New York, N. Y. App. filed Feb. 17, 1919. For welding joints of rails.

1,372,435. BATTERY-CELL COVER; Reginald M. Jones, Toronto, Ont., Canada. App. filed Dec. 12, 1919. Cover divided into plurality of separable sections.

1,372,437. TELEPHONE-SWITCH SEPARATOR; Henry Koch, Jamaica, N. Y. App. filed Oct. 20, 1919. Easily and quickly made.

1,372,442. ELECTROLYTIC GAS GENERATOR; Isaac H. Levin, New York, N. Y. App. filed May 22, 1917. To produce hydrogen and oxygen gases by subjecting water to electrolysis.

1,372,446. ERROR-PREVENTING TERMINAL FOR DYNAMOS; Friederich Munz, Stuttgart, Germany. App. filed May 4, 1920. Wrong connections between battery and dynamo prevented.

1,372,488. ELECTRICALLY HEATED SHOE CABINET AND METHOD OF USING SAME; Arthur A. Dionne, Brockton, Mass. App. filed April 28, 1920. For dressing, finishing and repairing shoes.

1,372,507. HANGER FOR TROLLEY WIRES; Thomas J. Henderson, Columbus, Ga. App. filed Aug. 7, 1920. Suspended insulator.

1,372,541. FIXATION OF THE NITROGEN OF THE ATMOSPHERE; Richard Pearson, London, England. App. filed Feb. 13, 1919. Electrically.

1,372,570. ELECTRICAL TESTING APPARATUS; Raymond Smith, Hazardville, Conn. App. filed Oct. 20, 1919. Attachment for standard flashlamps.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

PORTLAND, ME.—Freight-handling machinery will be installed by the Grand Trunk Railway Company, in connection with the proposed extensions to its steamship terminal at Portland, to cost about $500,000. The company is reported to be considering the erection of a new coaling plant at Deering to be equipped with electrically operated freight-handling machinery for loading, unloading, conveying, etc., to cost about $1,000,000.

BOSTON, MASS.—Considerable electrical and mechanical machinery will be installed in the three-story, 55-ft. x 500-ft. inspection and repair plant to be erected by the Boston Elevated Railroad Company at Forest Hills to cost about $500,000, including equipment.

SOUTH BRAINTREE, MASS.—Plans are being considered for rebuilding the factory of the Monatiquot Rubber Works, recently destroyed by fire. Considerable electrical equipment will be required. The cost of the new plant is estimated at $200,000.

WORCESTER, MASS. — The Worcester Electric Light Company has applied to the Department of Public Utilities for permission to issue $620,000 additional stock, the proceeds to be used for extensions, general operations, etc.

TOWNSHEND, VT. — Steps have been taken to form a company for the purpose of installing an electric lighting system in Townshend. J. H. Ware, C. H. Willard and others are interested.

Middle Atlantic States

ANTWERP, N. Y.—The Antwerp Light & Power Company has applied to the Public Service Commission for permission to erect an addition to its power plant and for approval of a franchise recently granted for lighting in this district.

CLARENCE, N. Y.—The proposal to install electric lamps along the highway from Transit Road and through the village of Clarence, a distance of 6 miles, is under consideration.

BURLINGTON, N. Y.—D. Thorne Gardner, Burlington, has been granted permission by the Public Service Commission for permission to erect an electric power plant at West Burlington and Edemston, Otsego County, with distribution lines in this section. Franchise has also been approved.

DANSVILLE, N. Y. — The Blum Shoe Manufacturing Company is considering the construction of a new power plant. As yet nothing definite has been decided upon S. N. Albert is purchasing agent.

FRIENDSHIP, N. Y.—The installation of an electric lighting and power system in Friendship is under consideration. Youngs & Son, who supply electricity to Belmont, Hume and other places, are interested.

MOUNT VERNON, N. Y. — Plans are being prepared by the McCormick Company, architects, Century Building, Pittsburgh, Pa., for the construction of a dairy plant, including a stable, garage and power plant for the Willow Brook Dairy Company, to cost about $250,000.

NEW YORK, N. Y.—Bids will be received by S. B. Wight, agent for the New York Central Lines, Grand Central Terminal, New York City, until April 19 for the requirements of said lines for one year, commencing April 1, 1921, of incandescent lamp bulbs, aggregating in excess of $300,000. These bulbs to be furnished in accordance with the New York Central Railroad Company's engineering department specification No. 3015, issue 2, dated July 10, 1920, copies of which may be obtained upon application to S. B. Wight, agent.

NEW YORK, N. Y.—Bids, it is reported will be opened about April 15 by W. Whitehall, architect and engineer, 12 Elm Street

for the construction of a substation on Greene Street, to cost about $160,000, and an addition to the substation on Cedar Street to cost about $130,000, for the New York Edison Company.

PERRY, N. Y.—The Perry Electric Light Company has applied to the Public Service Commission for permission to erect an electric power plant addition at Genessee Falls.

ROCHESTER, N. Y.—The Sibley, Lindsay & Curr Company has awarded a contract to A. W. Hopeman & Sons, 569 Lyell Avenue, for the construction of a new power plant in connection with its local department store.

ORMOND, N. J.—E. I. du Pont de Nemours & Company, Wilmington, Del., contemplate the construction of a one-story manufacturing plant, including an administration building and power house, in Manimuskin. The du Pont Engineering Company, du Pont Building, Wilmington, Del., are engineers.

BEAVER FALLS, PA.—The installation of a new ornamental lighting system on Seventh Avenue is under consideration. Electrical service is furnished by the Beaver County Light Company, Pittsburgh.

COLLEGE HILL, PA.—The Hill Light Company, recently organized, plans to install and operate an electric system in College Hill. C. J. Braun, Jr., 635 Sixth Avenue, Pittsburgh, is treasurer.

DANVILLE, PA.—The board of trustees of the Danville State Hospital contemplates the erection of a new power plant at the institution to cost about $65,000. William F. Shay, Watsontown, is president of the board.

EAST STROUDSBURG, PA.—Bids will be received by Luther Hoffman until April 15 for the installation of electric wiring and for all necessary electrical work at the General Hospital of East Stroudsburg.

ANNAPOLIS, MD.—The Annapolis Public Utilities Company, a subsidiary of the Washington, Baltimore & Annapolis Electric Railroad Company, has applied to the County Commissioners for permission to erect a pole line from a point near Iglehart's Station into the Sherwood Forest community to supply power for electric lamps and motors. H. T. Connolly is superintendent of power.

BALTIMORE, MD. — The Standard Oil Company contemplates the construction of a new power plant, 93 ft. x 142 ft., to cost about $50,000, at its plant at Third Avenue and Second Street, Canton.

BALTIMORE, MD.—The Chesapeake & Potomac Telephone Company plans to invest $3,500,000 during 1921 and 1922 for extensions to its system, including an expenditure of $800,000 to take care of station growth; erection of three additions to exchanges to cost $260,000; special equipment to connect exchanges $150,000; equipment of two other exchanges with electrical machinery $100,000, and conduit construction $250,000.

BETTERTON, MD.—Plans are under way for the installation of an electric lighting system in Betterton.

BLUEFIELD, W. VA.—Plans are being prepared for the construction of a cold-storage plant for the American Fruit Company, in which electrical and mechanical equipment will be installed.

LOGAN, W. VA.—Electric motors and other equipment will be installed in the addition, 110 ft. x 125 ft., to be erected by the Logan Ice & Storage Company. G. R. Travis is president and general manager.

SUTTON, W. VA.—The Sutton Chemical Company, it is reported, plans to begin work immediately on the construction of an electric power plant in the vicinity of its coal mines in Wolf Creek, Braxton County.

WHEELING, W. VA.—A petition has been presented to the City Council for the installation of an ornamental lighting system on parts of Wabasha Street, including the Wabasha Street Bridge; Robert Street, including the Robert Street Bridge; West Winifred and George Streets.

WASHINGTON, D. C.—Bids will be received at the office of the Chief Signal Officer of the Army, Washington, D. C., until April 22, proposal 5383-11CP, for furnishing twenty-seven transformers, SC type C-21. For further information address above.

WASHINGTON, D. C. — Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing the following: Until April 12, Washington, D. C., Schedule 7,832—125 battery-charging panels. Until April 15, Alexandria, Va., Schedule 7,810—five electric cranes; Portsmouth, Schedule 7,811—11,000 ft. of lighting and power wire. Until April 19, Washington, D. C., Schedule 7,845—1,000 lb. copper magnet wire. Until April 29, Mare Island, Cal., Schedule 7,858—2,500 ft. electric cable.

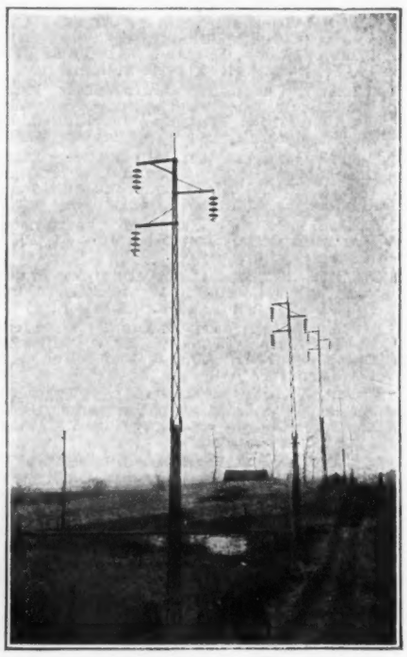
North Central States

FULTON, MICH.—Plans are under consideration for the installation of electric lamps in Fulton.

MARSHALL, MICH.—The construction of an auxiliary plant to the municipal light plant, to cost about $80,000, is under consideration by the Electric Light Commissioners.

COLUMBUS, OHIO.—The question of issuing $30,000 in bonds for street lighting in Bibb City will be submitted to the voters.

DEFIANCE, OHIO. — Considerable mechanical and electrical machinery, including power-plant equipment, will be installed in the plant to be built by the Farmers' Sugar Company, at an estimated cost of $1,000,000. A. H. Smith, 215 Nasby Building, Toledo, is architect. C. H. Allen is president.



NEW 66,000-VOLT LINE

New transmission line being constructed between Salem and Columbiana, Ohio, by Day & Zimmerman, Inc., for the Salem Lighting Company.

SPRINGFIELD, OHIO. — The sum of $19,700 has been appropriated for extensions to the park system, etc., of which $10,000 will be used for changes and extensions to the lighting system in Snyder Park.

SOUTH ELGIN, ILL.—At an election to be held April 19 the proposal to issue $5,000 in bonds for the purchase of street-lighting equipment will be submitted to the voters.

STERLING, ILL.—Extensions and improvements to the boulevard lighting system are under consideration. Mr. Tennant is chairman of a special committee.

WALTONVILLE, ILL. — The Southern Illinois Light & Power Company, Hillsboro, has applied to the Illinois Public Utilities Company to install an electric plant at Waltonville and erect a transmission line between Duquoin and Mount Vernon.

MILWAUKEE, WIS.—The City Council has ordered the city engineering department to prepare plans and specifications for the proposed new Riverside pumping station on the Milwaukee River to cost about $2,500,000. Percy Braman is Commissioner of Public Works.

FARGO, N. D.—At an election to be held in April the proposal to issue bonds to establish a municipal lighting plant will be submitted to the voters.

ELLINWOOD, KAN.—Improvements to the municipal electric light and water plant to cost about $40,000 are under consideration.

LYONS, KAN.—At the spring election the proposal to establish a municipal light plant in Lyons will be submitted to the voters.

OSBORNE, KAN.—The City Council is considering extensions to the municipal power plant to cost about $75,000. Archer & Stevens, 612 New England Building, Kansas City, Mo., are engineers.

Southern States

CHARLESTON, S. C.—Notice of increase in capital stock to $5,500,000 has been filed by the Charleston Consolidated Railway, Gas & Electric Company.

ALMA, GA.—The installation of an electric light plant in Alma is contemplated. J. H. McDonald is city clerk.

BAINBRIDGE, GA.—Electric light and water bonds to the amount of $20,000 have been voted.

FORT LAUDERDALE, FLA.—Arrangements are being made by the Southern Utilities Company to extend its lighting system to Las Olas Beach and Idlewyld.

GREENSBORO, ALA. — Arrangements have been made to lease the lighting system of the Greensboro Water & Light Company to be operated as municipal property. Extensions and improvements are under consideration.

LITTLE ROCK, ARK.—The City Council has appropriated funds for extensions to the street-lighting system. Present plans provide for 200 new incandescent lamps.

BOYNTON, OKLA.—Contract has been awarded to the Oklahoma Gas & Electric Company for the installation of street arc lamps in Boynton.

CHEROKEE, OKLA. — Bonds to the amount of $60,000 have been voted for extensions to the lighting plant and for fire equipment.

MAYSVILLE, OKLA.—Arrangements are under way for the erection of an electric transmission line from Pauls Valley to Maysville.

BALLINGER, TEX.—At an election to be held April 12 the proposal to issue $65,000 in bonds for the construction of an electric light and power plant will be submitted to the voters.

DALLAS, TEX.—Extensions to the lighting system on South Ervay Street to cost about $35,000 are under consideration by the Dallas Power & Light Company.

HALLETTSVILLE, TEX.—Bids will be received by S. M. Kuykendall, city secretary, until April 14 for improvements to the electric light plant, including a 120-hp. steam engine directly connected to a 90-kva., 2,300-volt, three-phase, 60-cycle alternating-current generator with exciter; switchboard panel for same; 150-hp. horizontal return-tubular boiler and fittings for both coal and oil fuel; 150-hp. open-type feed-water heater; two simplex boiler-feed pumps; necessary interconnecting pipe fittings, steam separator receiver, etc. Alternate bids will also be received on a 200-hp. steam engine directly connected to a 150-kva., 2,300-volt, three-phase, 60-cycle alternating-current generator with exciter; switchboard, boiler, heater, pumps and fittings as for previous item.

Pacific and Mountain States

SALEM, ORE. — The Oregon Pulp & Paper Company has applied to the State Engineer for permission to appropriate 465 sec.ft. of water from the north fork of the Santiam River for the development of about 1,300 hp.

TRACY, CAL.—The Trustees have adopted a resolution to install an electrolier system in Tracy. G. Frorics is clerk.

Canada

PENTICTON, B. C.—A movement has been started, it is reported, to extend the service of the West Kootenay Power & Light Company, Rossland, to Penticton. The plans would include the erection of a transmission line and a step-down transformer station to cost between $200,000 and $225,000. The erection of a secondary line to the up-the-lake section is also included in the project. Lorne Campbell is the manager.

ST. JOHN, N. B.—The Bathurst Electric Light & Water Power Company has petitioned the Public Utilities Commission for permission to increase its capital stock from $145,000 to $2,000,000 to provide funds for the enlargement of the dam at Great Falls.